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On the Systematic Importance of Spodograms in the Leaves of the Japanese Bambusaceae

By

Kiichi OHKI

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I. Introduction

Regarding the systematic studies of the Bambusaceae, there is already in existence a considerable mass of literature which at present may be regarded as attaining nearly to perfection. As to the taxonomy of the species, it is, however, by no means an easy matter or rather a very difficult task to know their correct names. For a long time I have been looking for some special method by which it may be possible to facilitate the work of identification. In the course of my study, Prof. B. HAYATA suggested that I take up for consideration the spodograms of the leaves of the plants belonging to the same family. It was mainly due to a paper by Prof. H. MOLISCH¹⁾ entitled "Aschenbild und Pflanzenverwandschaft" that Prof. B. HAYATA had this idea of availing of spodograms for the identification of Bamboos. Since that time I have been devoting myself to the study of spodograms, and as the result of

1) MOLISCH, H.—Aschenbild und Pflanzenverwandschaft, in Sitz.-bericht. d. Akad. Wiss. Wien. Math.—nat. Klasse, Abt. I, 129 Band, (1920), 5 u. 6 Heft, mit 3 Tafeln, S. 261-294.

my study I was able to find some microscopic characters which are available for such cases where a macroscopic observation fails to distinguish one species from another.

Materials used in the present paper are those which were given to me through the kindness of Prof. B. HAYATA, and those which are preserved in the Herbarium of the Botanical Institute, Faculty of Science, Imperial University of Tokyo. Besides I have made use of other materials cultivated in the Botanical Gardens of Koishikawa and Nikko, and those which were kindly sent to me by many friends from various quarters of the Empire. I have also added to these a few collected by myself.

In conclusion I avail of this opportunity to tender my hearty thanks to Prof. B. HAYATA for his kind suggestion and incessant encouragement during my work. To Prof. T. NAKAI I am under a great obligation for his kind advice and useful criticism, and to Dr. T. MAKINO for his cordial information as to the geographical distribution of species and the taxonomy of the latter.

Botanical Institute, Faculty of Science,
Imperial University of Tokyo, March 1931.

II. Technical Methods

More than two thousand preparations have been made by me for the present study by the following method which was first made public by O. WERNER.¹⁾ In 1928, that author planned a special apparatus for making the preparations of spodograms. In using the same apparatus, I have obtained spodograms much more conveniently than otherwise. It should be here noticed that in using this apparatus a much better result is obtained when it is operated for a longer time with weak fire than when operated for a short time with strong fire. Now, to make preparations:— cut a piece from the middle portions of leaves and again cut the same piece into several small pieces measuring 3–4 mm. in length, and 2–3 mm. in breadth, take these pieces into the apparatus, burn and heat them for 2–3 hours (some require only 10–13 minutes). In order to avoid breaking the spodograms, it is necessary to wait until they are cooled, then take them up on a slide, and add a few drops of xylol on them and finally close them with balsam. I have

1) WERNER, O.—Blatt-Aschenbilder heimischer Wiesengräser als Mittel ihrer Verwandschafts- und Wertbestimmung, in *Biologia Generalis*, IV. (1928), S. 403–446.

observed more than two thousand preparations thus obtained under the microscope of 500–800 magnifications. The figures given in the present paper are drawn by means of ABBÉ's "Zeichenapparat."

III. Analytical Key to Genera, Spodograms being taken as Principal Criteria

- 1 { Silica cells are not found in the epidermis above the assimilation tissue on the under surface of a leaf. 1. *Shibatara* MAKINO
- 1 { Silica cells are found in the epidermis above the assimilation tissue on the under surface of a leaf. 2
- 2 { Silica corpuscles (Kieselkörper) are found on either or both sides of the longer rectangular cells of a leaf. 2. *Dendrocalamus* NEES ab ESENBECK
- 2 { Silica corpuscles are hardly ever found on either or both sides of the longer rectangular cells of a leaf. 3
- 3 { Silica cells in the upper epidermis above the veins are comparatively short, and are nearly dumb-bell shaped or rectangular in form. . 3. *Bambusa* SCHREBER
- 3 { Silica cells in the upper epidermis above the veins are nearly rectangular, ovate or elliptical in shape 4
- 4 { When an articulation band consists of 3 cell-rows, the length of the same cells in the middle row is nearly equal to the width, or may be shorter or longer 4. *Sasa* MAKINO et SHIBATA
- 4 { 5. *Pseudosasa* MAKINO
- 4 { 6. *Sasaella* MAKINO
- 5 { When an articulation band consists of 3 cell-rows, the articulation cells in the middle row are mostly measured more in their length than in their width . 5
- 5 { When an articulation band consists of 3 cell-rows, the articulation cells in the middle row are generally 11.6–24.9 μ wide, even in an exceptional case measure at least 10 μ in width. 7. *Semiarundinaria* MAKINO
- 5 { When an articulation band consists of 3 cell-rows, the articulation cells in the middle row are generally 3.3–16.6 μ wide; but some of them are sometimes less than 10 μ in width. 6
- 6 { Silica corpuscles in the articulation cells are especially numerous. 8. *Sinobambusa* MAKINO
- 6 { 9. *Chimonobambusa* MAKINO
- 7 { Silica corpuscles in the articulation cells are few in number or are not found . 7
- 7 { Silica cells in the upper epidermis above the veins are mostly 2.5–10 μ long; and in some species, in addition to such a short silica cell stomata measuring more than 28 μ in length are found in the under epidermis 10. *Pleiblastus* NAKAI
- 7 { Silica cells in the upper epidermis above the veins are about 4.9–10 μ or more long, and stomata in the under epidermis are shorter than about 27 μ in length. 11. *Phyllostachys* SIEBOLD et ZUCCARINI

Note: According to the key just mentioned, the spodograms of the leaves of the Bambusaceae may be classified into the following 8 types:—

- | | |
|-------------------------------------|-----------------------------------|
| 1. the <i>Shibataea</i> type; | 2. the <i>Dendrocalamus</i> type; |
| 3. the <i>Bambusa</i> type; | 4. the <i>Sasa</i> type; |
| 5. the <i>Semiarundinaria</i> type; | 6. the <i>Sinobambusa</i> type; |
| 7. the <i>Pleioblastus</i> type; | 8. the <i>Phyllostachys</i> type. |

IV. Description of the Spodograms of Species

1. *Shibataea* MAKINO

MAKINO, in Bot. Mag. (Tokyo) XXVIII. (1914) p. 22.

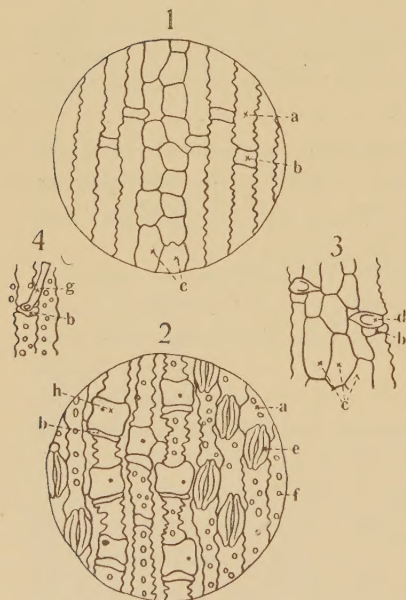


Fig. 1. *Shibataea* Kumasasa MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells. 4. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell found in the epidermis on a vein. \times ca. 194.

1. *Shibataea* Kumasasa MAKINO (Fig. 1), 1. c.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $28.2-74.7\mu$ long, $8.3-11.6\mu$ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $4.2-8.3\mu$ long, 10μ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about 4.9μ in length, 11.6μ in breadth, their walls being flat, very few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist

of several cell rows nearly parallel to the veins. Between any two bands of them, there exists the band of articulation cells. The latter are nearly rectangular or polygonal in shape, their walls being slightly undulate or flat. The number of cell rows constituting the band varies mostly 2-4, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $13.3-24.9\mu$ long, $8.3-16.6\mu$ wide, and those in the lateral rows are about $13.3-24.9\mu$ long, $6.6-16.6\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6-18.3\mu$ in length, $8.3-13.3\mu$ in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are scarcely found. Hairs are 1-celled, very few in number. No geniculate hair. A few silica cells containing an especially large mass of silica are seldom found in the epidermis above the veins. They are nearly rectangular in form, about $8.3-14.9\mu$ in length, $16.6-19.9\mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. Those belonging to the same row are arranged with an interval of about $33.2-166\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6-33.2\mu$ in length, $8.3-14.9\mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9-24.9\mu$ in length, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated one from another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, very numerous in number. Geniculate hairs are 2-celled, their walls being smooth, very few in number. They are found mainly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells exist everywhere. They are only on the under surface of the leaf. Silica cells are not found in the epidermis above the assimilation tissue. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3-18.3\mu$ in length, $13.3-26.6\mu$ in breadth, disposed in 1-3 or more

rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $3.3\text{--}152.7\mu$ or more.

The following points are worthy of special attention:—

1. Silica cells are seldom found in the epidermis above the veins on the upper surface.
2. Geniculate hairs do not exist on the upper surface.
3. Silica cells are not found in the epidermis above the assimilation tissue on the under surface.

NOM. JAP. Okame-zasa, Bungo-zasa.

HAB. Japan, Spontaneous and cultivated.

2. *Dendrocalamus* NEES ab ESENBECK

NEES ab ESENBECK, in *Linnaea* IX. (1834) p. 476; MUNRO
Monograph (1866) p. 146.

2. *Dendrocalamus latiflorus* MUNRO (Fig. 2), l. c. p. 152; MATSUMURA, *Index Pl. Jap.* II. (1905) p. 92; MATSUMURA et HAYATA, *Enum. Pl. Formos.* (1906) p. 555; NEMOTO and MAKINO, *Fl. Jap.* (1925) p. 1444.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $26.5\text{--}83\mu$ in length, $8.3\text{--}16.6\mu$ in breadth, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly wavy or flat, nearly perpendicular to the longer sides. The silica corpuscles (Kieselkörper) are found on either or both of their lateral sides. Between any two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and shorter. The shorter rectangular cells are about $3.3\text{--}8.3\mu$ long, $16.6\text{--}21.6\mu$ wide, their walls being wavy or flat. The silica cells are nearly rectangular in form, about $2.5\text{--}6.6\mu$ in length, $9.3\text{--}16.6\mu$ in breadth, their walls being flat, numerous in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands there exists the band of articulation cells. The latter are nearly rectangular, elliptical or polygonal in shape, their walls being slightly wavy or flat. The number of cell rows constituting the band varies 2–5 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the same cells in the middle row are about $9.9\text{--}33.2\mu$ long, $6.6\text{--}18.3\mu$ wide, and those in the lateral rows are about $8.3\text{--}16.6\mu$ long, $16.6\text{--}18.3\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex,

about 24.9μ in length, 13.2μ in diameter, very few in number. They are found on the epidermis near the margin. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. No ordinary hair. Geniculate hairs are 2-celled, very few in number. They exist chiefly on the epidermis near the margin. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\mu$ in length, $8.3\text{--}13.3\mu$ in breadth, disposed in 1 or more rows nearly parallel to a vein. Those belonging to the same row are separated from one another with the interval of about $4.2\text{--}83\mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

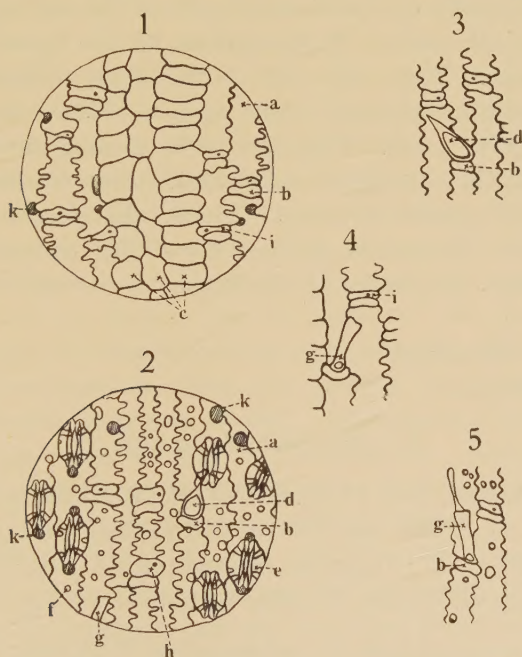


Fig. 2. *Dendrocalamus latiflorus* MUNRO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell. 4. Portion of the upper epidermis with a geniculate hair. 5. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 16.6μ in length, 8.3μ in diameter, numerous in number. Viewed from a side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 21.7 – 26.7μ in length, very numerous in number, disposed mostly in 3–4 rows nearly parallel to a vein. They exist in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated one from another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found mostly on the epidermis above the assimilation tissue or rarely on that of the veins. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about 4.9 – 13.3μ in length, 13.3 – 24.9μ in breadth, disposed mostly in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about 4.9 – 116.2μ or more.

NOTE: Silica corpuscles (Kieselkörper) are found in longer rectangular cells.

NOM. JAP. Ma-chiku.

HAB. Formosa.

3. *Bambusa* SCHREBER

SCHREBER, Gen. Pl. no. 607. (1789); ROXBURGH, Fl.

Ind. II. (1832) pp. 190–192; RUPRECHT, Bambus.

(1839) p. 47; GAMBLE, in HOOKER Fl. Brit. Ind.

VII. (1897) p. 386; CAMUS, Bambus. (1913) p. 115.

As to the spodogram of the epidermis of the leaves, I have usually observed it from above (i. e. from the outer side). The following descriptions of spodograms are taken from the preparations made from the middle portion of a leaf (i. e. nearly an inch square on both sides of the midrib). I have omitted those from both the basal and the apical portions.

A. General remarks

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about 18.2 – 166μ long, 4.9 – 19.9μ

wide, their two longer sides strongly wavy or slightly undulate or rarely straight, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and shorter cells. The shorter rectangular cells are about $2.5-15\ \mu$ long, $4.9-21\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $1.6-6.6\ \mu$ in length, $6.6-16.6\ \mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is found the band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being slightly undulate or flat. The number of cell rows constituting the band varies 2-3 or more, according to the distance from the midrib. Spine cells are found or not found. Those spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $3.9-150\ \mu$ in length, $9.9-33.2\ \mu$ in diameter, few or numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-26.6\ \mu$ in length, few in number. No finger-like protuberance exists around stomata on the upper surface. Hairs are found or not found. When present, they are 1-celled, very few in number. Geniculate hairs are present or absent; when present, they are 2-celled, their walls being smooth, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $3.3-9.9\ \mu$ in length, $9.9-24.9\ \mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $5-166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble in general those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $6-85\ \mu$ in length, $6-30\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $15-26.6\ \mu$ in length, very numerous in number, disposed mostly in 2-3 or more rows nearly parallel to a vein. They

are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Ordinary hairs are 1-celled, few or numerous

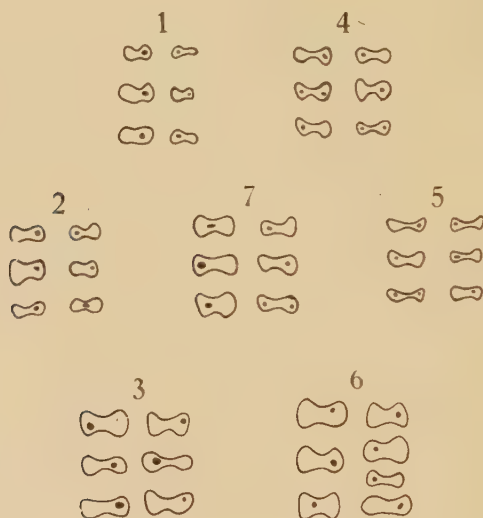


Fig. 3. Different kinds of silica cells in the upper epidermis above the veins in the different species of the genus. The epidermis are taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without.

1, *Bambusa Oldhami* MUNRO; 2, *B. stenostachya* HACKEL; 3, *B. dolichomerithalla* HAYATA; 4, *B. Shimadai* HAYATA; 5, *B. nana* Roxburgh; 6, *B. dolichoclada* HAYATA; 7. *B. breviflora* MUNRO. \times ca. 194.

in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They are only on the under surface of the leaves. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}15\ \mu$ in length, $8.3\text{--}27\ \mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

B. Key to the species

- 1 { Geniculate hairs are found on the upper surface of leaves. 3
- 1 { Geniculate hairs are scarcely found on the upper surface of leaves. 2
- 2 { Spine cells are few in number on the upper surface of leaves. 3. *Bambusa Oldhami* MUNRO
- 2 { Spine cells are very numerous in number on the upper surface of leaves. 4. *B. stenostachya* HACKEL
- 3 { Spine cells are scarcely found on the under surface of leaves. 5. *B. dolichomerithalla* HAYATA
- 3 { Spine cells are seen on the under surface of leaves. 4
- 4 { Stomata in the epidermis on the under surface are mostly shorter than 20μ in length 6
- 4 { Stomata in the epidermis on the under surface are 20μ or more in length. . . 5
- 5 { The number of cell rows constituting the articulation band varies mostly 2-3, according to the distance from the midrib 6. *B. Shimadai* HAYATA
- 5 { The number of cell rows constituting the articulation band varies 2-3 or more, according to the distance from the midrib 7. *B. nana* ROXBURGH
- 6 { The number of cell rows constituting the articulation band varies about 2-4, according to the distance from the midrib . . . 8. *B. dolichoclada* HAYATA
- 6 { The number of cell rows constituting the articulation band varies mostly 2-4 or more, according to the distance from the midrib . 9. *B. breviflora* MUNRO

C. Description

3. *Bambusa Oldhami* MUNRO (Fig. 4), Monograph Bambus. (1866) p. 109; MATSUMURA et HAYATA, Enum. Pl. Formos. (1906) p. 550.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $18.2-120\mu$ long, $8.3-15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or flat, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $6-9\mu$ long, $6-15\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about $4.9-6.6\mu$ in length, $11.6-14.9\mu$ in breadth, their walls being flat, numerous in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is located the band of articulation cells. The latter are nearly rectangular or

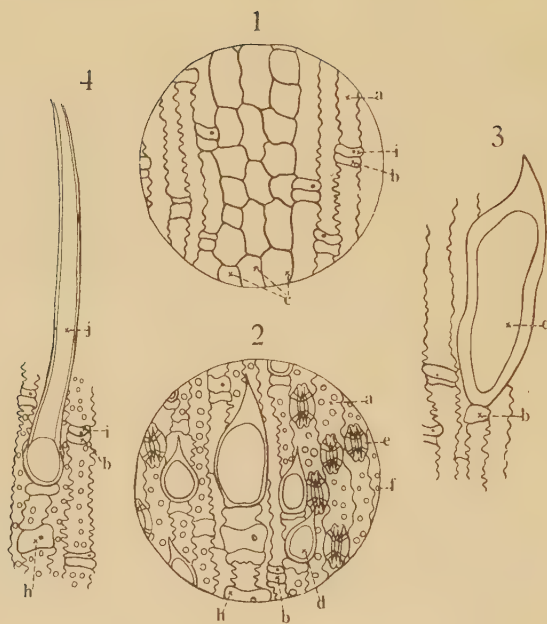


Fig. 4. *Bambusa Oldhami* MUNRO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell 4. Portion of the under epidermis with an ordinary hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; h, silica cell in the epidermis above a vein; i, silica cell in the epidermis on the assimilation tissue; j, ordinary hair. \times ca. 194.

polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies 2-7, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells are about $13.3-33.2 \mu$ long, $9.9-21.6 \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $39-90 \mu$ in length, $24-30 \mu$ in diameter, few in number. They are mainly found on the epidermis near the margin. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are scarcely found. Neither ordinary nor geniculate hair is found. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $3.3-8.3 \mu$ in length, $11.6-$

18.3 μ in breadth, disposed mostly in a single row nearly parallel to a vein. Those in a row are arranged with the interval of about 24–135 μ .

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly ovate or elliptical, rounded at the base, cuspidate or acute at the apex, about 27–85 μ in length, 12–30 μ in diameter, numerous in number. Viewed from the side they are nearly rostrate in form, projecting a little above the surface. Stomata are nearly elliptical, about 21–24 μ in length, very numerous in number, disposed mostly in 3–4 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, comparatively numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number, found mainly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells exist everywhere. They are found only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about 6–15 μ in length, 8.3–27 μ in breadth, disposed mostly in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about 1.6–166 μ or more.

The following points may be mentioned as worthy of attention:—

1. Geniculate hairs are not found on the upper surface of leaves.
2. Spine cells are seen on the upper surface of leaves.

NOM. JAP. Ryoku-chiku.

HAB. Formosa.

4. *Bambusa stenostachya* HACKEL (Fig. 5), in Bull. Herb. Boiss. VII. (1899) p. 725; MATSUMURA et HAYATA, Enum. Pl. Formos. (1906) p. 550.

a) *Epidermal cells constituting the upper surface of leaves* are mostly many longer rectangular cells. They are about 35.5–166 μ long, 8.3–13.3 μ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell lying between them. The shorter rectangular cells are about 3.3–5 μ long, 11.6 μ wide, their walls being slightly wavy or flat.

The silica cells are nearly rectangular in form, about $2.5-3.3\ \mu$ in length,

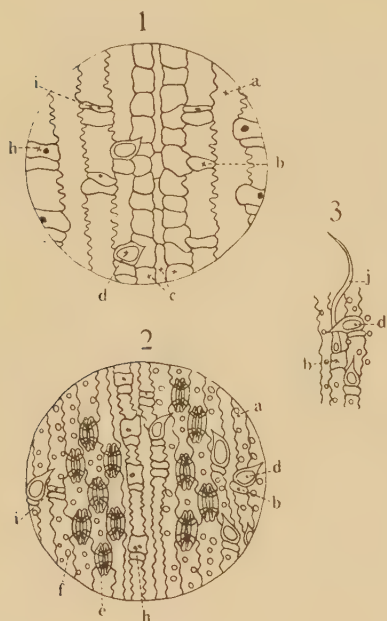


Fig. 5. *Bambusa stenostachya* HACKEL

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with spine cells and an ordinary hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance, g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue; j, ordinary hair \times ca. 194.

$8.3-11.6\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands there is the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies about 2-5, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $9.9-24.9\ \mu$ long, $1.6-3.3\ \mu$ wide, and those in the lateral rows are about $8.3-13.3\ \mu$ long, $4.9-8.3\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6-50\ \mu$ in length, $8.3-20\ \mu$ in diameter, very numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6\ \mu$ in length, few in number. No finger-like protuberance exists around stomata on the upper surface. Ordinary hairs are not nearly found. Geniculate

hairs are scarcely found. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $8.3-9.9\ \mu$ in length, $9.9-16.6\ \mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $8.3-75\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $23.2\text{--}40\ \mu$ in length, $9.9\text{--}16.6\ \mu$ in diameter, comparatively numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6\text{--}20\ \mu$ in length, numerous in number, disposed in mostly 2–5 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, very numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}13.3\ \mu$ in length, $8.3\text{--}11.6\ \mu$ in breadth, disposed mostly in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $3.3\text{--}112.8\ \mu$.

The following points may be mentioned as worthy of attention:—

1. Ordinary and geniculate hairs are scarcely found on the upper surface of the leaves.
2. Numerous spine cells exist on the upper surface of the leaves.
3. Very numerous hairs are found on the under surface of the leaves.

NOM. JAP. Shi-chiku.

HAB. Formosa.

5. *Bambusa dolichomerithalla* HAYATA, Ic. Pl. Formos. VI. (1916) p. 146.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $19.9\text{--}100\ \mu$ long, $8.3\text{--}11.6\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter cell. The shorter rectangular cells are about

6.6–11.6 μ long, 11.6–16.6 μ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 3.3–4.9 μ in length, 6.6–8.3 μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is located the band of articulation cells. The latter cells are nearly polygonal in shape, their walls being wavy or flat. The number of cell rows in this band is mostly 3–9, varying according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about 16.6–24.9 μ long, 4.9–9.9 μ wide, and those in the lateral rows are about 8.3–16.6 μ long, 8.3–16.6 μ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 24.9–83 μ or more in length, 16.6–33.2 μ in diameter, comparatively numerous in number. Viewed from the side they are nearly rostrate in form, projecting a little above the surface. Stomata are nearly elliptical, about 24.9–26.6 μ in length, very few in number. No finger-like protuberance exists around stomata on the upper surface. No ordinary hair. Geniculate hairs are 2-celled, very few in number. Several silica cells containing an especially large mass of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about 6.6–9.9 μ in length, 14.9–24.9 μ in breadth, disposed mostly in a single row nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about 8.3–157.7 μ .

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are scarcely found. Stomata are nearly elliptical, about 21.5–26.6 μ in length, numerous in number, disposed mostly in 2–4 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of the stoma. Ordinary hairs are 1-celled, very numerous in number. They are found on the epidermis above the assimilation tissue and veins. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are seen everywhere. They exist only on the under surface of the leaves. Silica cells containing es-

pecially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}11.7\ \mu$ in length, $11.6\text{--}20\ \mu$ in breadth, disposed mostly in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $3.3\text{--}75\ \mu$.

In observing the spodogram of this species, attention should be paid to the following points:—

1. Geniculate hairs are found on the upper surface of the leaves.
2. Spine cells are scarcely seen on the under surface of the leaves.
3. Numerous hairs exist on the under surface of the leaves.

NOM. JAP. Hifuki-dake.

HAB. Formosa.

6. *Bambusa Shimadai* HAYATA, Ic. Pl. Formos. VI. (1916) p. 151.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $18.3\text{--}74.7\ \mu$ long, $6.6\text{--}16.6\ \mu$ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or flat, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $4.9\text{--}6.6\ \mu$ long, $6.6\text{--}14.9\ \mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular or triangular in form, about $1.6\text{--}3.3\ \mu$ in length, $9.9\text{--}16.6\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there exists the band of articulation cells. The latter cells are polygonal in shape, their walls being slightly undulate or flat. The number of cell rows constituting the band varies mostly 2–3, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $14.9\text{--}33.2\ \mu$ long, $4.9\text{--}8.3\ \mu$ wide, and those in the lateral rows are about $13.3\text{--}24.9\ \mu$ long, $9.9\text{--}16.6\ \mu$ wide. No spine cell. Stomata are not found. No hair. Geniculate hair are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped, about $6.6\text{--}8.3\ \mu$ in length, $14.9\text{--}18.3\ \mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $23.2\text{--}66.4\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $19.9\text{--}44.8\ \mu$ in length, $8.3\text{--}19.9\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9\text{--}24.9\ \mu$ in length, numerous in number, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found mostly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells exist everywhere only on the under surface of the leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular or lenticular in form, about $4.9\text{--}13.3\ \mu$ in length, $9.9\text{--}19.9\ \mu$ in breadth, disposed mostly in 1-3 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $8.3\text{--}124.5\ \mu$.

The following points should be mentioned as worthy of attention:—

1. Geniculate hairs are found on the upper surface of the leaves.
2. Spine cells exist on the under surface of the leaves.
3. Some stomata in the epidermis on the under surface are $20\ \mu$ or more in length.

NOM. JAP. *Sekikaku-chiku*.

HAB. *Formosa*.

7. ***Bambusa nana* ROXBURGH**, Fl. Ind. II. (1832) p. 199; MUNRO, in Trans. LINN. Soc. XXVI. (1868) p. 89; GAMBLE, in HOOKER Fl. Brit. Ind. VII. (1897) p. 390; HACKEL, in Bull. Herb. Boiss. VII. (1899) p. 720; MATSUMURA et HAYATA, Enum. Pl. Formos. (1906) p. 549.

a) Epidermal cells constituting the upper surface of leaves are mostly longer rectangular cells. They are about $24.9\text{--}132.8\ \mu$ long, $4.9\text{--}19.9\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides

there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $2.5-10\ \mu$ long, $4.9-19.9\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3-5\ \mu$ in length, $8.3-13.3\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands there exists the band of articulation cells. The latter cells are nearly polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies mostly 2-7, according to the distance from the midrib. When the articulation band consists of 3 cell rows, the articulation cells are about $9.9-28.2\ \mu$ long, $6.6-16.6\ \mu$ wide. Spine cell are found, few in number. Stomata are nearly elliptical, about $16.6-21.6\ \mu$ in length, very few in number. No finger-like protuberance exists around stomata on the upper surface. No hair. Geniculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $4.9-8.3\ \mu$ in length, $13.3-19.9\ \mu$ in breadth, disposed mostly in 1-2 rows nearly parallel to a vein. Those in a row are arranged with the interval of about $5-166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6-33.2\ \mu$ in length, $9.9-13.3\ \mu$ in diameter, few in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $23.2-26.6\ \mu$ in length, numerous in number, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of the stomata. Ordinary hairs are 1-celled, few in number. Geniculate hairs are 2-celled, their walls being mostly smooth, few in number. Protuberances on the epidermal cells are found everywhere. They are seen only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6-11.6\ \mu$ in length, $9.9-16.6\ \mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those

belonging to the same row are arranged with the interval of about $8.3-166\ \mu$ or more.

For the investigation of the spodogram of this species attention should be paid to the following points:—

Ordinary hairs are not found on the upper surface of the leaves.

NOM. JAP. Hôwô-chiku.

HAB. Formosa.

8. *Bambusa dolichoclada* HAYATA (Fig. 6), Ic. Pl. Formos. VI. (1916) p. 144.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $15-75\ \mu$ long, $9-18\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-15\ \mu$ long, $7.5-21\ \mu$ wide, their walls being wavy or flat. The silica cells are nearly rectangular in form, about $3\ \mu$ in length, $9-12\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands there is located the band of articulation cells. These cells are polygonal in shape, their walls being wavy or flat. The number of cell rows consisting of the band varies about 2-4, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $11.6-24.9\ \mu$ long, $6.6-9.9\ \mu$ wide, and those in the lateral rows are about $8.3-16.6\ \mu$ long, $6.6-16.6\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15-124.5\ \mu$ in length, $11.6-33.2\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $23.3\ \mu$ in length, very few in number. No finger-like protuberance exists around stomata on the upper surface. No ordinary hair. Geniculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $4.9-9.9\ \mu$ in length, $18.3-24.9\ \mu$ in breadth,

disposed mostly in a single row nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $6-90\ \mu$.

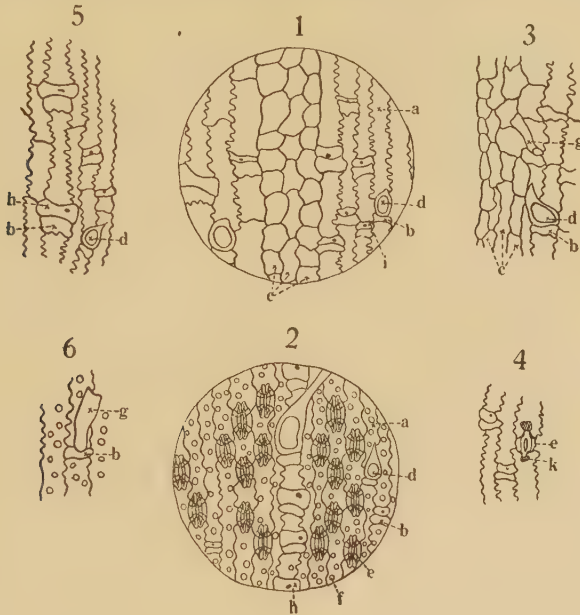


Fig. 6. *Bambusa dolichoclada* HAYATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell and a geniculate hair. 4. Portion of the upper epidermis with a stoma. 5. Portion of the upper epidermis on a vein. 6. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue; k, silica corpuscle. \times ca. 194.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $6-24\ \mu$ in length, $6-12\ \mu$ in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $15\ \mu$ in length, very numerous in number, disposed mostly in 3 or more rows nearly parallel to a vein. They are found in

the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Ordinary hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are seen everywhere. They exist only on the under surface of leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form or dumb-bell shaped, about $6-12\mu$ in length, $6-18\mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $9-84\mu$.

The following points are worthy of attention :—

1. Geniculate hairs are present on the upper surface of the leaves.
2. Spine cells are easily found on the upper surface of the leaves.
3. Stomata in the epidermis on the under surface are shorter than 25μ in length.

NOM. JAP. Tyoshi-chiku.

HAB. Formosa.

9. *Bambusa breviflora* MUNRO (Fig. 7), in Trans. Linn. Soc. XXVI. (1868) p. 96 ; MATSUMURA et HAYATA, Enum. Pl. Formos. (1906) p. 549.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $50-100\mu$ long, $6.6-11.6\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3.3-6.6\mu$ long, $8.3-16.6\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $1.6-3.3\mu$ in length, $8.3-11.6\mu$ in breadth, their walls being flat, numerous in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is located a band of articulation cells. The latter are nearly rectangular or polygonal in shape, their walls being slightly wavy or flat. The number of cell rows constituting the band varies mostly 2-6, according to the distance from the midrib. When the articulation band

consists of 3 cell-rows, the same cells in the middle row are about $13.3\text{--}24.9\mu$ long, $6.6\text{--}9.9\mu$ wide, and those in the lateral rows are about $8.3\text{--}21.6\mu$ long, $6.6\text{--}16.6\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}83\mu$ in length, $11.6\text{--}33\mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are scarcely found. No ordinary hair. Genuiculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly dumb-bell shaped or rectangular in form, about $6.6\text{--}8.3\mu$ in length, $16.6\text{--}21.6\mu$ in breadth, their walls being flat, disposed mostly in a single row nearly parallel to a vein. Those in the same row are arranged with the interval of about $16.6\text{--}58.1\mu$.

b) *Epidermal cells constituting the under surface of the leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 16.6μ in length, $8.3\text{--}16.6\mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 16.6μ in length, numerous in number, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated one

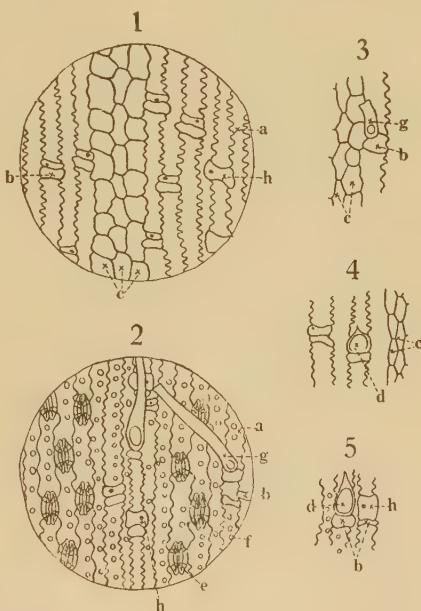


Fig. 7. *Bambusa breviflora* MUNRO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a genuiculate hair. 4. Portion of the upper epidermis with a spine cell. 5. Portion of the under epidermis with a spine cell. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, genuiculate hair; h, silica cell in the epidermis on a vein. \times ca. 194.

from another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number, found on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}13.3\ \mu$ in length, $9.9\text{--}16.6\ \mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $8.3\text{--}90\ \mu$.

The following points are worthy of attention:—

1. Geniculate hairs are found on the upper surface of the leaves.
2. Spine cells exist on the under surface of the leaves.
3. Stomata in the epidermis on the under surface are shorter than $25\ \mu$ in length.

NOM. JAP. Kobana-dake.

HAB. Formosa.

4. *Sasa* MAKINO et SHIBATA

MAKINO and SHIBATA, in Bot. Mag. (Tokyo) XV. (1901) p. 18.

In studying the spodograms of epidermis which constitute both upper and under surface of the leaves, I have usually observed it from the outer side. The following descriptions of the epidermal cells are those of the middle portions of sufficiently old leaves. Those of the apical and basal portions are omitted.

A. General remarks

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly the longer rectangular cells. They are about $16.6\text{--}166\ \mu$ long, $6.6\text{--}24.9\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell with or without a silica cell on its side of the longer cells. The shorter rectangular cells are about $2\text{--}19.9\ \mu$ long, $6.6\text{--}24.9\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $2.4\text{--}8.3\ \mu$ in length, $6.6\text{--}24.9\ \mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the

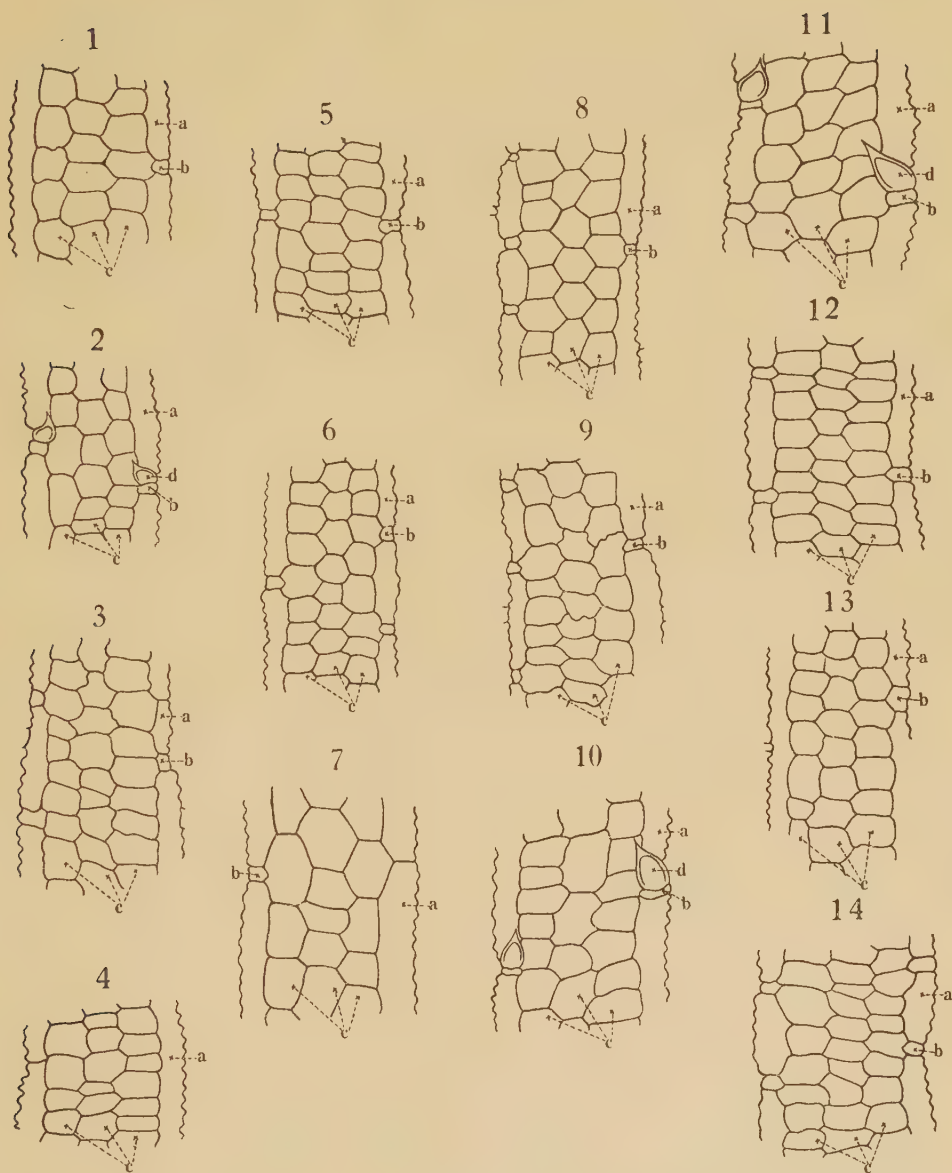


Fig. 8. Different aspects of articulation bands of the different species of the genus in the upper epidermis on one side of the midrib between two extremities (apex and base) of a leaf, seen from without.

1. *Sasa paniculata* MAKINO et SHIBATA; 2. *S. iyoensis* NAKAI; 3. *S. coreana* NAKAI; 4. *S. nipponica* MAKINO et SHIBATA; 5. *S. Hayatae* MAKINO; 6-7. *S. tyuhoensis* MAKINO; 8. *S. Tokugawana* MAKINO; 9. *S. Makinoana* HAYATA; 10-11. *S. butchensis* MAKINO; 12. *S. kurilensis* MAKINO et SHIBATA; 13. *S. Tsuboiana* MAKINO; 14. *S. Veitchii* REHDER a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, Spine cell. \times ca. 216.

other without silica), make a number of bands which are named for convenience's sake ordinary bands and consist of several cell rows nearly parallel to the veins. Between two bands of this kind, there is found a band of articulation cells which band may be called the articulation band. The articulation cells are nearly rectangular or polygonal in shape, about $8.3\text{--}33.2\mu$ in length, $6.6\text{--}33.2\mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the articulation band varies 1–3 or more, according to the distance from the midrib. Spine cells are found or not found. These cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6\text{--}161\mu$ in length, $6.6\text{--}49.8\mu$ in diameter, few or numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $18.2\text{--}31.5\mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface, which are, however, found in those on the under surface. Hairs are found or not found. These hairs are 1-celled, and are few in number. Geniculate hairs exist or do not exist. These are 2-celled, and are few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. These portions of the epidermis above the veins are called the vein band. These cells are nearly rectangular or ovate in form, about $2.5\text{--}24.9\mu$ in length, $3.3\text{--}26.6\mu$ in breadth, disposed here and there in 1–3 or more rows. Those which belong to the same row are arranged with the interval of about $0.8\text{--}166\mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $13.2\text{--}74.7\mu$ in length, $8.3\text{--}28.2\mu$ in diameter, a few or numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9\text{--}29.9\mu$ in length, very numerous in number, disposed mostly in 2–5 or more rows nearly parallel to a vein. This portion of the epidermis is called the stomata band. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata which belong to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to cover the stomata. Hairs are found or not found. These hairs are 1-celled, and are few,

or numerous in number. Geniculate hairs exist or do not exist. These hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate. They are, if exist, few or comparatively numerous in number. They are found on the epidermis above the assimilation tissue or veins. Protuberances on the epidermal cells are found everywhere. They are found existing only in the epidermis constituting the under surface of leaves. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $2.5-25.9 \mu$ in length, $3.3-33.2 \mu$ in breadth, disposed in 1-3 or more rows nearly parallel to the veins. Those which belong to the same row are arranged with the interval of about $1.6-166 \mu$ or more.

B. Key to the species

- 1 { The number of cell rows constituting a band of articulation cells varies 1-3 or more, according to the distance from the midrib on the upper surface . . . 3
- 1 { The number of cell rows constituting a band of articulation cells varies 1-3, according to the distance from the midrib on the upper surface 2
- 2 { Spine cells are not found on the upper surface. Ordinary hairs are not found on the under surface. 10. *Sasa paniculata* MAKINO et SHIBATA
- 2 { Spine cells are found on the upper surface. Ordinary hairs are found very numerous in number on the under surface. 11. *S. iyoensis* NAKAI
- 3 { The walls of geniculate hairs on the under surface are smooth. 4
- 3 { The walls of geniculate hairs on the under surface are smooth or slightly serrate. 6
- 4 { Hairs are not found on the under surface. 12. *S. coreana* NAKAI
- 4 { Hairs are present on the under surface 5
- 5 { The geniculate hairs are found mostly on the epidermis above the assimilation tissue on the under surface. 13. *S. nipponica* MAKINO et SHIBATA
- 5 { The geniculate hairs are found on the epidermis above the assimilation tissue or rarely above the veins on the under surface. . . 14. *S. Hayatae* MAKINO
- 6 { Geniculate hairs are present very few in number on the upper surface. . . . 7
- 6 { Geniculate hairs are not found on the upper surface. 11
- 7 { Hairs are not found on the upper surface. 8
- 7 { Hairs are found on the upper surface. 10
- 8 { Hairs are not found on the under surface. Geniculate hairs are found on the epidermis above the assimilation tissue or veins on the under surface . . 9
- 8 { Hairs are found on the under surface. Geniculate hairs are found mostly on the epidermis above the assimilation tissue on the under surface. 15. *S. Tokugawana* MAKINO
- 9 { Spine cells are comparatively numerous on the upper epidermis near the margin. Silica cells in the upper epidermis above the veins are about $3.3-16.6 \mu$ long $8.3-18.3 \mu$ wide. 16. *S. tyuhgokensis* MAKINO
- 9 { Spine cells are found a very few in number or nearly not at all on the upper epidermis near the margin. Silica cells in the upper epidermis above the veins are about $3.3-23.2 \mu$ long, $11.6-24.9 \mu$ wide . . 17. *S. Veitchii* REHDER

- 10 { Hairs exist on the under surface. 18. *S. Makinoana* HAYATA
 { Hairs do not exist on the under surface. 19. *S. bilchuensis* MAKINO
 11 { Spine cells are not seen on the upper surface . 20. *S. nebulosa* (MAKINO) OHKI
 { Spine cells are seen on the upper surface. 12
 12 { A few hairs exist on the upper surface. Stomata to be found in the epider-
 mis on the under surface are about 24.9–28.2 μ long.
 { 21. *S. kurilensis* MAKINO et SHIBATA
 { Hairs are not found on the upper surface. Stomata existing in the epider-
 mis on the under surface are below about 25 μ long. 13
 13 { Hairs are found on the under surface. 14
 { Hairs are not found on the under surface. 22. *S. stenantha* NAKAI
 { Silica cells to be seen in the epidermis above the veins on the upper surface
 are mostly below about 20 μ in length and width. . 23. *S. nana* MAKINO
 14 { Some silica cells existing in the epidermis above the veins on the upper
 surface are about 20 μ or more in length and width.
 { 24. *S. Tsuboiana* MAKINO

C. Descriptions

10. *Sasa paniculata* MAKINO et SHIBATA (Fig. 9), in Bot. Mag. (Tokyo) XV. (1901) p. 25; MAKINO, Jour. Jap. Bot. V. (1928) p. 4; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1495.

a) *Epidermal cells constituting the greater portion of the upper surface* are mostly longer rectangular cells. They are about 26.5–107 μ long, 11.6–19.9 μ wide, two longer sides being strongly wavy, parallel to the midrib, the other shorter sides being slightly undulate or straight nearly perpendicular to the veins. Between two longer rectangular cells, and in contact with their shorter side, there exists a small shorter rectangular cell, with or without a silica cell which lies between the longer and the shorter. The shorter cells are about 2–8.3 μ long, 8.3–15 μ wide, their walls being slightly wavy or flat. The silica cells are few in number, nearly rectangular in form, about 3.3–5 μ in length, 9.9–11.7 μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one not containing silica and the other containing silica), compose a number of bands which consist of several rows of cells parallel to the midrib. Between any two bands, there is found a band of articulation cells. The latter are nearly rectangular or polygonal in shape, about 14.9–29.9 μ in length, 11.6–29.9 μ in breadth, their walls being slightly wavy or flat. The number of cell rows in this band is mostly 1–3, which varies according to the distance from the midrib. Neither spine cell nor ordinary hair nor geniculate ones are found. Stomata are nearly elliptical, about 23.2–28.2 μ in length, and few in

number. No. finger-like protuberance covering the stomata exists on the upper surface which protuberance is found on the under surface. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. These cells are nearly rectangular or ovate in form, about $3.3\text{--}16.6\mu$ in length, $9.9\text{--}21.6\mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $4.9\text{--}166\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* resemble those of the upper surface, but they show some difference in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $39.8\text{--}72\mu$ in length, $18.2\text{--}25\mu$ in diameter, very numerous in number. Some have one or more protuberances on either side of the base. Viewed from the side, they are rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6\text{--}28.2\mu$ in length, numerous in number, disposed mostly in 3-4 rows in the epidermis above the assimilation tissue existing on both sides of a vein. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far

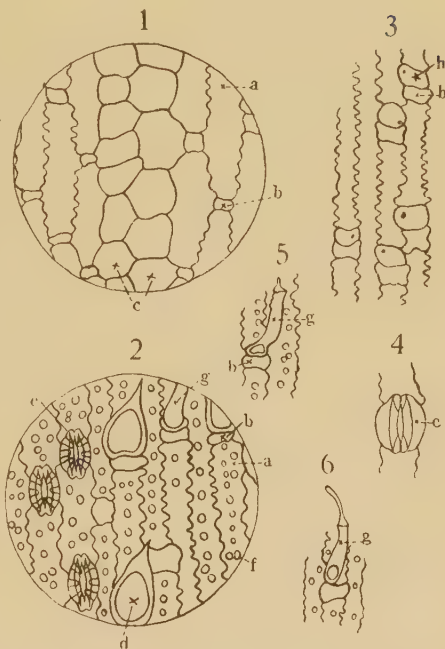


Fig. 9. *Sasa paniculata* MAKINO et SHIBATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis above a vein. 4. Portion of the upper epidermis with a stoma. 5-6. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein.

× ca. 194.

as the length a of longer rectangular cell. No ordinary hair. Genuiculate hairs are 2-celled, the walls of their basal cells being smooth or rarely serrate. They are found on the epidermis above the veins or the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaves. A few silica cells containing especially large masses of silica are found or are not found in the epidermis above the veins. They are nearly rectangular or ovate in form, about $6.6\text{--}20\mu$ in length, $3.3\text{--}20\mu$ in breadth, disposed mostly in 1–5 rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $3.3\text{--}160\mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows in the articulation band is mostly 1–3, which varies according to the distance from the midrib.
2. Neither spine cell nor ordinary hair nor genuiculate ones are on the upper surface of the leaves.

NOM. JAP. Nemagari-dake.

HAB. Honshū.

11. *Sasa iyoensis* NAKAI, in sched. Herb. Imp. Univ. Tokyo.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $24.9\text{--}74.7\mu$ long, $8.3\text{--}14.9\mu$ wide, two longer sides being remarkably wavy, nearly parallel to the midrib, and the other shorter sides being slightly wavy or straight nearly perpendicular to the veins. Between two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell. They are about $3.3\text{--}8.3\mu$ long, $8.3\text{--}13.3\mu$ wide, their walls being slightly wavy or flat. These cells of two kinds, one longer, the other shorter, compose a number of bands which consist of several rows of cells parallel to the midrib. Between two bands, there is found a band of articulation cells. The latter are nearly rectangular or polygonal in shape, about $13.3\text{--}33.2\mu$ in length, $9.9\text{--}16.6\mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows in this band is mostly 1–3, which varies according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6\text{--}92.9\mu$ in length, $6.6\text{--}21.2\mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in form, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $19.9\text{--}24.9\mu$ in length, few in number. No finger-like protuberance adjoining to the stomata exists on the upper surface which protuberance is found on the under

surface. Hairs are 1-celled, few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}19.9\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. The cells belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $19.9\text{--}71.4\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9\text{--}24.9\ \mu$ in length, numerous in number, disposed in about 3–4 rows parallel to the veins. They are found in the epidermis above the assimilation tissue existing on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to cover the stomata. Hairs are 1-celled, very numerous in number. Geniculate hairs are 2-celled, the walls of their basal cells being slightly serrate or smooth. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}18.3\ \mu$ in length, $16.6\text{--}33.2\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows in the articulation band is mostly 1–3.
2. Spine cells are found on the epidermis on the upper surface of the leaves.
3. The walls of geniculate hairs are slightly serrate or smooth.

NOM. JAP.

HAB. Shikoku.

12. *Sasa coreana* NAKAI (Fig. 10), in Bot. Mag. (Tokyo) XXXI. (1917) p. 4.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $18.2\text{--}66.4\ \mu$ long, $6.6\text{--}19.9\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and two other shorter sides being

slightly undulate or straight nearly perpendicular to the longer sides. Between two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell with or without a silica cell which lies between the longer and the shorter. The shorter rectangular cells are about $6.6-9.9\mu$ long, $8.3-9.9\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3-4.9\mu$ in length, $13.2-14.9\mu$ in breadth, their walls

being flat and few in number. These cells of three kinds, one longer, the other two shorter (one with silica and the other without silica), make a number of bands which consist of several rows of cells parallel to the midrib. Between two bands, there is found a band of articulation cells. The latter are nearly rectangular or polygonal in shape, about $9.9-24.9\mu$ in length, $9.9-24.9\mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows in this band is mostly 1-5, which varies according to the distance from the midrib. Spine cells are nearly elliptical, about $13.2-152.7\mu$ in length, $8.3-49.8\mu$ in diameter, and are very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $18.3-20.8\mu$ in length, and are few in number. No finger-like protuberance located next the stomata on the upper surface which protuberance is found in those on the under surface. Hairs are 1-celled, very few in number. They are found existing only near the margin. No geniculate hair. Several silica cells containing especially

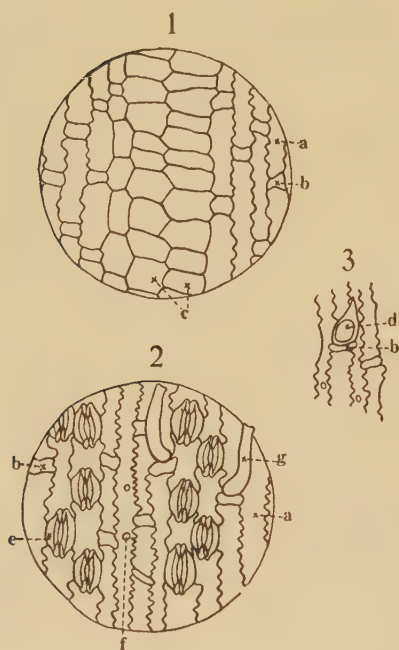


Fig. 10. *Sasa coreana* NAKAI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without.
2. under epidermis taken from the nearly middle portion on one side of the midrib, seen from without.
3. Portion of the under epidermis with a spine cell.

a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair. \times ca. 194.

large masses of silica are found in the epidermis above the veins. They are nearly elliptical or ovate in form, about $4.9\text{--}14.9\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed mostly in 1-3 rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but they show some difference in the following points :—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $13.2\text{--}24.9\ \mu$ in length, $9.9\text{--}11.6\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5\text{--}26.5\ \mu$ in length, numerous in number, disposed in mostly 2-3 rows parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of the stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found on the epidermis above the assimilation tissue or rarely on the veins. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaves. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}16.6\ \mu$ in length, $13.2\text{--}14.9\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $4.9\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points :—

1. The number of cell rows in an articulation band varies 1-3 or more, according to the distance from the midrib.
2. The walls of the geniculate hairs existing on the under surface are smooth.
3. Hairs are not found on the under surface.

NOM. JAP. Korai-zasa.

HAB. Corea.

13. *Sasa nipponica* MAKINO et SHIBATA (Fig. 11), in Bot. Mag. (Tokyo) XV. (1901) p. 24; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 149; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1495.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $23.2\text{--}132.8\ \mu$ long, $8.3\text{--}18.3\ \mu$ wide, their two longer sides being strongly wavy, parallel to the midrib, the other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between

the longer and the shorter.

These shorter rectangular cells are about $2.5\text{--}8.3\ \mu$ long, $4.9\text{--}16.6\ \mu$ wide, their cell walls slightly wavy or straight. The silica cells are nearly rectangular in form, about $1.6\text{--}3.3\ \mu$ in length, $11.6\ \mu$ in breadth, few in number. Epidermal cells of these three kinds, one longer, two shorter, compose a number of bands which consist of several cell rows parallel to the viens. Between two bands, there is found a band of articulation cells. The latter are nearly rectangular or polygonal in shape, about $8.3\text{--}19.9\ \mu$ in length, $9.9\text{--}19.9\ \mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the band varies mostly 1–5, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $13.2\text{--}100\ \mu$ in length, $9.9\text{--}11.6\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in form, projecting a little

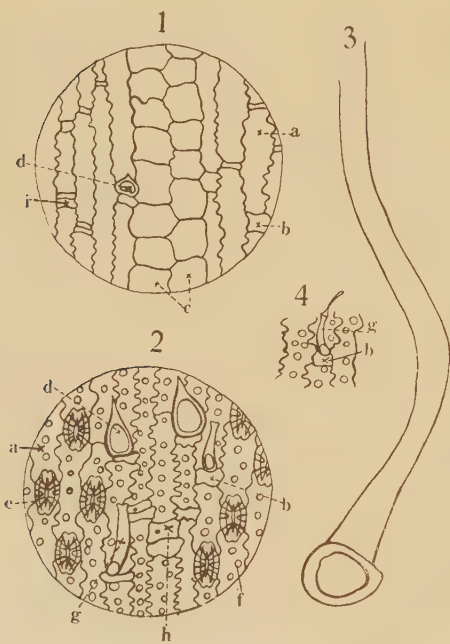


Fig. 11. *Sasa nipponica* MAKINO et SHIBATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Ordinary hair to be found on the under epidermis. 4. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

above the surface. Stomata are nearly elliptical, about $21.5\text{--}24.9\ \mu$ in length, few in number. No finger-like protuberance on the cells adjoining to stomata exists on the upper surface which protuberance is found on those on the under surface. Hairs are 1-celled, few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\ \mu$ in length, $11.6\text{--}13.3\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $35.9\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}61.4\ \mu$ in length, $9.9\text{--}24.9\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5\text{--}24.9\ \mu$ in length, numerous in number, disposed in mostly 3-4 rows parallel to the veins. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They exist on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}11.6\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. The silica cells which belong to the same row are arranged with the interval of about $8.3\text{--}133.1\ \mu$.

To investigate the spodogram of this species, attention should be paid to the following points:—

1. The number of cell rows in a band of the articulation cells varies 1-3 or more, according to the distance from the midrib.
2. The walls of the geniculate hairs on the under surface are smooth.
3. Hairs are present on the under surface.
4. The geniculate hairs on the under surface are found mostly on the epidermis above the assimilation tissue.
5. Geniculate hairs are not found on the upper surface.

NOM. JAP. Miyako-zasa.

HAB. Honshū, kyushū.

14. *Sasa Hayatae* MAKINO (Fig. 12), Journ. Jap. Bot. III. (1926) p. 16.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. These cells are about $19.9\text{--}99.6\ \mu$ long, $8.3\text{--}21.6\ \mu$ wide, two longer sides being strongly wavy, nearly parallel to the midrib, two other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter side, there exists a small shorter rectangular cell with or without a silica cell lying between the longer and shorter. The shorter rectangular cells are about $4.9\text{--}11.6\ \mu$ long, $11.6\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $4.2\text{--}6.6\ \mu$ in length, $11.6\text{--}14.9\ \mu$ in

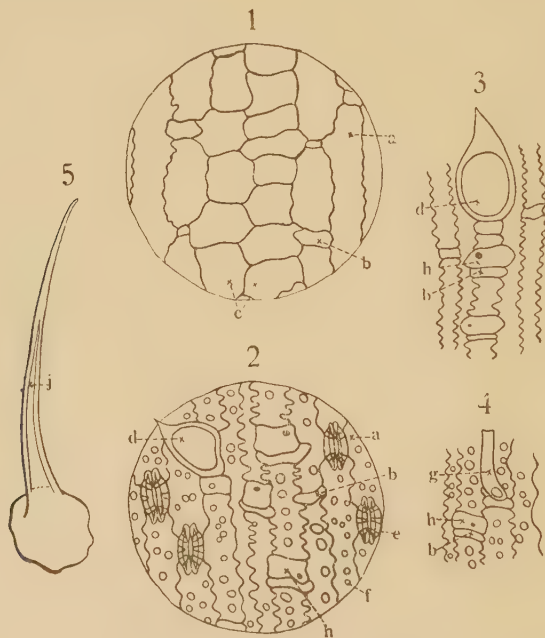


Fig. 12. *Sasa Hayatae* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis on a vein with a spine cell. 4. Portion of the under epidermis with a geniculate hair. 5. Ordinary hair as found on the under epidermis. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell as found in the epidermis on a vein; j, ordinary hair. \times ca. 194.

breadth, their walls being flat. These cells of three kinds, one longer and two shorter (one not containing silica and the other containing silica), compose a number of bands which consist of several rows of cells parallel to the midrib. Between two bands, there is found a band of articulation cells. The latter are nearly rectangular or polygonal in shape, about $8.3\text{--}21.6\ \mu$ in length, $9.9\text{--}21.6\ \mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows in this band is mostly 2-5, which varies according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $78\text{--}99.6\ \mu$ in length, $21.6\ \mu$ in breadth, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface of leaves. Stomata are nearly elliptical, about $19.9\text{--}23.2\ \mu$ in length, very few in number. No finger-like protuberance exists near stomata on the upper surface which protuberance is found on the under surface. Hairs are 1-celled, few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}13.3\ \mu$ in length, $16.6\text{--}21.6\ \mu$ in breadth, disposed mostly in 1-row parallel to the veins. Those which belong to the same row are arranged with the interval of about $2.4\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $33.2\text{--}59.8\ \mu$ in length, $18.3\text{--}28.2\ \mu$ in breadth, comparatively numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}26.6\ \mu$ in length, numerous in number, disposed mostly in 3 rows parallel to the veins. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to cover the stoma. Hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number, existing on the epidermis above the the assimilation tissue or veins. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about

6.6–18.2 μ in length, 16.6–26.6 μ in breadth, disposed in 1–3 or more rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about 3.3–97.9 μ .

To investigate the spodogram of this species, attention should be paid to the following points:—

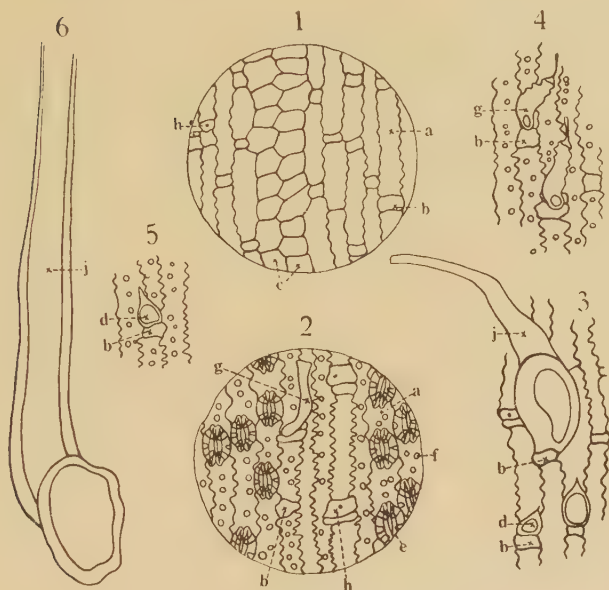
1. The number of cell rows in a band of the articulation cells varies 2–5, according to the distance from the midrib.
2. Geniculate hairs existing on the under surface are found on the epidermis above the assimilation tissue or rarely above veins, and their walls are smooth.
3. Geniculate hairs are absent on the upper surface.

NOM. JAP. Miyama-kumazasa.

HAB. Honshū.

15. *Sasa Tokugawana* MAKINO (Fig 13), Journ. Jap. Bot. I. (1916) p. 6.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about 28.2–74.7 μ long, 8.3–21.2 μ wide, two longer sides being strongly wavy, nearly parallel to the midrib, two other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell with or without a silica cell lying between the longer and shorter. The shorter rectangular cells are about 4.9–14.9 μ long, 11.6 μ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about 3.3–4.9 μ in length, 9.9–11.6 μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter, (one not containing silica and the other containing silica) make a number of bands which consist of several rows of cells parallel to the veins. Between two bands, there lies a band of articulation cells. These cells are polygonal or nearly rectangular in shape, about 8.3–24.9 μ in length, 11.6–19.9 μ in breadth, their walls being slightly undulate or straight. The number of cell rows in this band is mostly 1–7, which varies according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 11.6–49 μ or more in length, 13.2–24.9 μ or more in breadth, comparatively numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. No hair. Geniculate hairs are 2-celled, very few in number. Stomata are nearly elliptical, about 19.9–27 μ in length, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form,

Fig. 13. *Sasa Tokugawana* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells and an ordinary hair. 4. Portion of the under epidermis with geniculate hairs. 5. Portion of the under epidermis with a spine cell. 6. Ordinary hair as found on the under epidermis. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; h, silica cell in the epidermis on a vein; j, ordinary hair. \times ca. 194.

about $8.3\text{--}19.9\ \mu$ in length, $11.6\text{--}21.6\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $3.3\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* resemble those of the upper surface, but they show some difference in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6\text{--}28.2\ \mu$ in length, $9.9\text{--}21.6\ \mu$ in diameter, numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9\ \mu$ in length, very numerous in number, disposed mostly in 3–4 rows in the epidermis above the assimilation tissue located

on both sides of a vein. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Hairs are 1-celled, their walls being smooth, numerous in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, comparatively numerous in number. They exist on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}9.9\ \mu$ in length, $11.2\text{--}28.2\ \mu$ in breadth, disposed in mostly 1–3 rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $1.6\text{--}116\ \mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows in a band of the articulation cells varies mostly 1–7, according to the distance from the midrib.
2. The walls of the basal cells of the geniculate hairs existing on the under surface are smooth or rarely serrate.
3. Geniculate hairs are present on the upper surface.
4. Hairs are not found on the upper surface.
5. Hairs are present on the under surface.
6. Geniculate hairs on the under surface are found mostly on the epidermis above the assimilation tissue.

NOM. JAP. Tokugawa-zasa.

HAB. Honshū.

16. *Sasa tyuhokensis* MAKINO, Jour. Jap. Bot. IV. (1927) p. 3.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $24.9\text{--}137.8\ \mu$ long, $8.3\text{--}18.3\ \mu$ wide, their two longer sides being strongly wavy, parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer cell and itself. The shorter rectangular cells are about $4.9\text{--}8.3\ \mu$ long, $11.6\text{--}14.5\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}4.9\ \mu$ in length, $9.9\text{--}11.6\ \mu$ in breadth, their walls being flat. These cells of three kinds,

one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows parallel to the midrib. Between two of these bands, there is found a band of articulation cells. The same cells are nearly rectangular or polygonal in shape, about $8.3\text{--}38.2\ \mu$ in length, $13.3\text{--}24.9\ \mu$ in width, their walls being slightly wavy or flat. The number of cell rows constituting the band varies mostly 1–4, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}24.9\ \mu$ in length, $9.9\text{--}13.3\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $23.2\text{--}24.9\ \mu$ in length, few in number. No finger-like protuberance exists near stomata on the upper surface, which protuberance is found on the under surface. No hair. Genuiculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}16.6\ \mu$ in length, $8.3\text{--}18.3\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}49.8\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in diameter, very few in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}26.6\ \mu$ in length, numerous in number, disposed in 3–4 or more rows nearly parallel to a vein. These stomata belonging to the same row separate from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center so as to cover the stomata. No hair. Genuiculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, comparatively numerous in number. They exist on the epidermis above the assimilation tissue or veins. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}16.6\ \mu$ in length, $8.3\text{--}23.3\ \mu$ in breadth, disposed mostly in 1–3 or more rows parallel to the veins.

Those belonging to the same row are arranged with the interval of about $6.6\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows in a band of the articulation cells varies mostly 1–4, according to the distance from the midrib.
2. Geniculate hairs are found on the upper surface.
3. Geniculate hairs existing on the under surface are found mostly on the epidermis above the assimilation tissue or veins. The walls of their basal cells are smooth or rarely rough.
4. Hairs are not present on both upper and under surfaces of leaves.

NOM. JAP. Chûgoku-zasa.

HAB. Honshû.

17. *Sasa Veitchii* REHDER (Fig. 14), in Journ. Arnold Arb. I. (1919) p. 58; NAKAI, l. c. p. 150.

a) *Epidermal cells constituting a greater part of the upper surface of the leaves* are mostly longer rectangular cells. They are about $29.9\text{--}119.5\ \mu$ long, $9.9\text{--}18.3\ \mu$ wide, two longer sides being strongly wavy, nearly parallel to the midrib, two other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there is located a small shorter rectangular cell, with or without a silica cell lying between the longer and the shorter. The shorter rectangular cells are about $5\text{--}8.3\ \mu$ long, $8.3\text{--}16.6\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}8.3\ \mu$ in length, $8.3\text{--}11.6\ \mu$ in breadth, numerous in number, their walls being flat. These cells of three kinds, one longer, two shorter (one not containing silica and the other containing silica), make a number of bands each of which consists of several rows of cells parallel to the midrib. Between the two bands just mentioned, there is found a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, about $8.3\text{--}16.6\ \mu$ in length, $21.6\text{--}24.9\ \mu$ in breadth, their walls being slightly undulate or flat. The number of cell rows in this band is mostly 1–5, which varies according to the distance from the midrib. Spine cells are nearly elliptical, about $24.9\text{--}58.1\ \mu$ in length, $13.2\text{--}24.9\ \mu$ in diameter, very few in number, existing only near the margin. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $18.3\text{--}31.5\ \mu$ in length, few in number. No finger-like protuberance

around the stomata exists on the upper surface. No ordinary hair. Geniculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}23.3\mu$ in length, $11.6\text{--}24.9\mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about $0.8\text{--}166\mu$ or more.

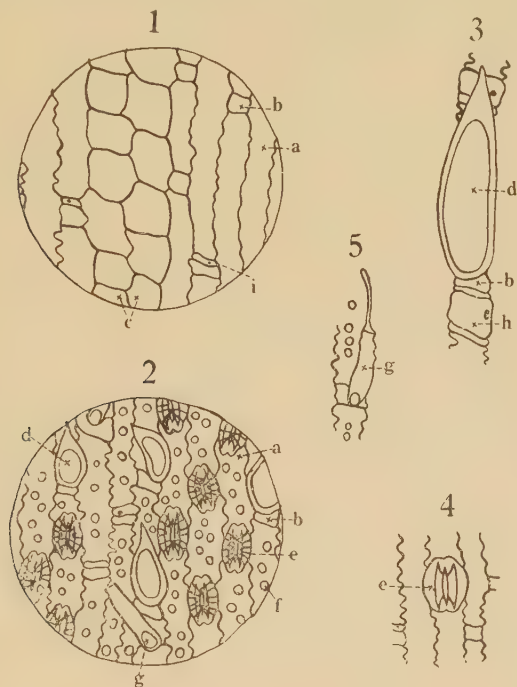


Fig. 14. *Eusa Veitchii* REHDER

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell. 4. Portion of the upper epidermis with a stoma. 5. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $36.5\text{--}74.7\mu$ in length, $16.6\text{--}26.6\mu$ in breadth, very numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are

nearly elliptical, about $21.5\text{--}24.9\mu$ in length, numerous in number, disposed in mostly 2-3 or more rows parallel to the veins. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center so as to cover the stomata. No ordinary hair. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, found on the epidermis above the assimilation tissue or veins. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\mu$ in length, $9.9\text{--}23.2\mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $3.3\text{--}166\mu$ or more.

For the investigation of the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows in the band of articulation varies mostly 1-5, according to the distance from the midrib.
2. A very few spine cells are present on the upper surface.
3. Ordinary hairs are not found on the upper and under surface.
4. Geniculate hairs are rarely found on the upper surface.
5. The walls of the geniculate hairs on the under surface are smooth or somewhat rough.
6. Many spine cells are present on the under surface.

NOM. JAP. Kuma-zasa.

HAB. Widely cultivated.

18. *Sasa Makinoana* HAYATA (Fig. 15), in sched. Herb. Imp. Univ. Tokyo.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $33.2\text{--}124.5\mu$ long, $8.3\text{--}18.3\mu$ wide, their two longer sides being remarkably wavy, parallel to the midrib, and the other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there lies a small shorter rectangular cell with or without a silica cell between the longer cell and itself. The shorter rectangular cells are about $4.9\text{--}9.9\mu$ long, $8.3\text{--}23.3\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}4.9\mu$ in length. 11.6--

13.3μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows parallel to the midrib. Between two of these bands there is located a band of articulation cells. These cells are nearly rectangular or polygonal in shape, about $8.3\text{--}24.9\mu$ in length, $9.9\text{--}33.2\mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows forming the band varies 1–3 or more, according to the distance from the midrib. Spine cells are

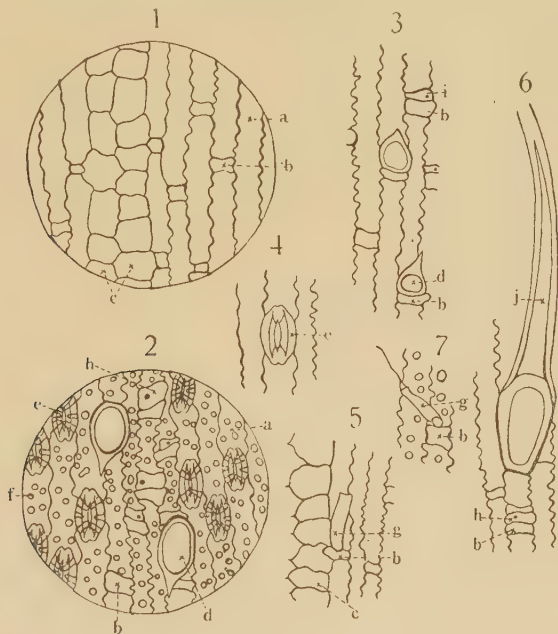


Fig. 15. *Sasa Makinoana* HAYATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with two spine cells. 4. Portion of the upper epidermis with a stoma. 5. Portion of the upper epidermis with a geniculate hair. 6. Portion of the upper epidermis with an ordinary hair. 7. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue; j, ordinary hair. \times ca. 194.

nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}161\mu$ in length, $13.2\text{--}44.8\mu$ in breadth, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}28.2\mu$ in length, few in number. No finger-like pro-

tubérance exists near the stomata on the upper surface, which protubérance is found in those on the under surface. Hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, few in number. They are found on the epidermis near the margin. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}16.6\ \mu$ in length, $11.6\text{--}19.9\ \mu$ in breadth, disposed mostly in 1–3 rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $19.9\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $26.5\text{--}94.6\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}29.9\ \mu$ in length, numerous in number, disposed in mostly 3–4 rows parallel to a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to cover the stomata. Hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, few in number. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}21.6\ \mu$ in length, $3.3\text{--}14.9\ \mu$ in breadth, disposed mostly in 1–3 rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

To investigate the spodiogram of this species it is necessary to pay attention to the following points:—

1. The number of cell rows consisting of a band of articulation cells varies 1–3 or more, according to the distance from the midrib.
2. Ordinary hairs and geniculate hairs are present on the upper surface.
3. The walls of the geniculate hairs existing on the under surface are smooth or slightly serrate.
4. Many hairs are found on the under surface.

NOM. JAP. Fujisan-kumazasa.

HAB. Honshū.

19. *Sasa bitchuensis* MAKINO (Fig. 16), in Bot. Mag. (Tokyo) XXVIII. (1914) p. 31; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 149; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1495.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $24.9\text{--}166\ \mu$ long, $8.3\text{--}19.9\ \mu$ wide, their two longer sides being remarkably wavy, parallel to the midrib, and the other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there is a small shorter rectangular cell with or without a silica cell inserted between the longer and the shorter. The shorter rectangular cells are about $5\text{--}8.3\ \mu$ long, $5\text{--}16.6\ \mu$ wide, their cell walls being slightly wavy, or flat. The silica cells are nearly rectangular or elliptical in form, about $3.3\text{--}5\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in breadth, their cell walls being flat, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), compose a number of bands which consist of several cell rows parallel to the midrib. Between two bands of the same cell rows, there is found a band of articulation cells. The same cells are nearly rectangular or polygonal in shape, about $8.3\text{--}33.2\ \mu$ in length, $13.3\text{--}24.9\ \mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the same band varies 1–5 or more, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $14.9\text{--}41.5\ \mu$ in length, $8.3\text{--}19.9\ \mu$ in breadth, numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly ovate or elliptical, about $24.9\text{--}28.2\ \mu$ in length, few in number. No finger-like protuberance exists around stomata found on the upper surface. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}16.6\ \mu$ in length, $14.9\text{--}29.4\ \mu$ in breadth, disposed mostly in 1–3 rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about $8.3\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $23.2\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in diameter, few

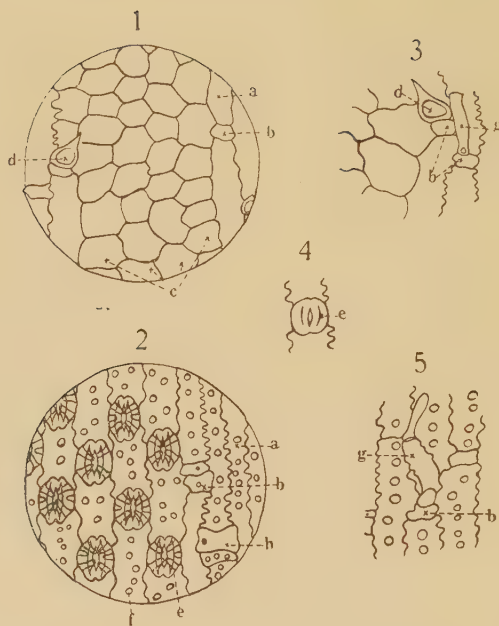


Fig. 16. *Sasa bitchuensis* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell and a geniculate hair. 4. Portion of the upper epidermis with a stoma. 5. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein. \times ca. 194.

in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $21.6\text{--}29.9\mu$ in length, numerous in number, disposed in 4–5 or more rows parallel to the veins. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to cover the stomata. No hair. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}24.9\mu$ in length, $5\text{--}28.2\mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. These silica cells

which belong to the same row are arranged with the interval of about $1.6-166\ \mu$ or more.

To investigate the spodogram of this species, attention should be paid to the following points :—

1. The number of cell rows constituting the band of articulation varies 1-5 or more, according to the distance from the midrib.

2. Ordinary hairs and geniculate hairs are found on the upper surface.

3. The walls of the geniculate hairs existing on the under surface are smooth or slightly serrate.

4. Hairs are not found on the under surface.

NOM. JAP. Jobo-zasa.

HAB. Honshū

20. *Sasa nebulosa* (MAKINO et SHIBATA) OHKI (Fig. 17), in Bot. Mag. (Tokyo) XLII. (1928) p. 311.

Syn. *Arundinaria paniculata* f. *nebulosa* MAKINO, in Bot. Mag. (Tokyo) XIV. (1900) p. 52.

Bambusa palmata f. *nebulosa* MAKINO, l. c. p. 61.

Sasa paniculate f. *nebulosa* MAKINO et SHIBATA, in Bot. Mag. (Tokyo) XV. (1901) p. 27; CAMUS, *Bambus*. (1913) p. 24; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1496.

S. senanensis f. *nebulosa* REHDER, in Journ. Arnold. Arb. I. (1914) p. 58.

a) *Epidermal cells constituting the epidermis on the upper surface* are mostly longer rectangular cells. They are about $16.6-89.3\ \mu$ long, $8.3-24.9\ \mu$ wide, two longer sides being strongly wavy, nearly parallel to the midrib, two other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell with or without a silica cell which lies between the longer and the shorter. The shorter rectangular cells are about $6.6-11.6\ \mu$ long, $6.6-24.9\ \mu$ wide, their walls being flat or slightly wavy. The silica cells are nearly rectangular in form, about $3.3-8.3\ \mu$ in length, $9.9-13.3\ \mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands each of which consists of several cell rows parallel to the veins. Between two of these bands, there is found a band of articulation cells. These cells are nearly rectangular or polygonal in shape, about $8.3-24.9\ \mu$ in length, $11.6-16.6\ \mu$ in breadth, their walls being wavy or straight. The number of cell rows constituting

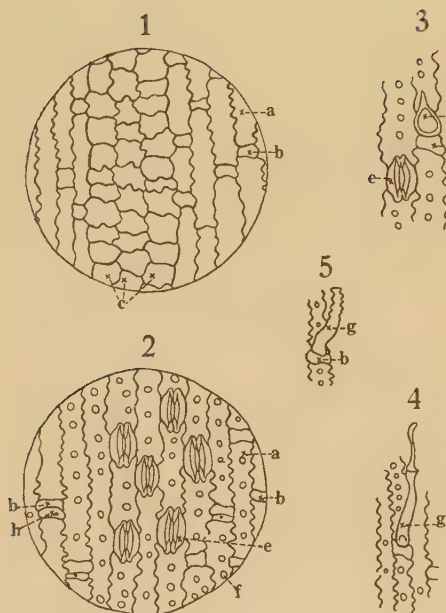


Fig. 17. *Sasa nebulosa* (MAK. et SHIB) OHKI.

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with a spine cell. 4-5. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein. \times ca. 194.

this band varies 1-4, according to the distance from the midrib. No spine cell. Stomata are nearly elliptical, about $24.9-31.5 \mu$ in length, very few in number. No finger-like protuberance around the stomata exists on the upper surface. Neither ordinary hair nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3-16.6 \mu$ in length, $11.6-26.6 \mu$ in breadth, disposed mostly in 1-3 or more rows parallel to the veins. These silica cells which belong to the same row are arranged with the interval of about $1.6-166 \mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but they show some difference in the following points;—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $19.9-24.9 \mu$ in length, 13.3μ in breadth, very few in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5-23.2 \mu$ in length, numerous in number, disposed mostly in 3-4 rows in the epidermis above the assimilation tissue locating on both sides of a vein. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. Hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or rarely serrate, comparatively numerous in number. They exist on the epidermis above the assimilation tissue or rarely on veins. Protuberances on the

epidermal cells are found everywhere. They are found existing only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}16.6\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, attention should be paid to the following points:—

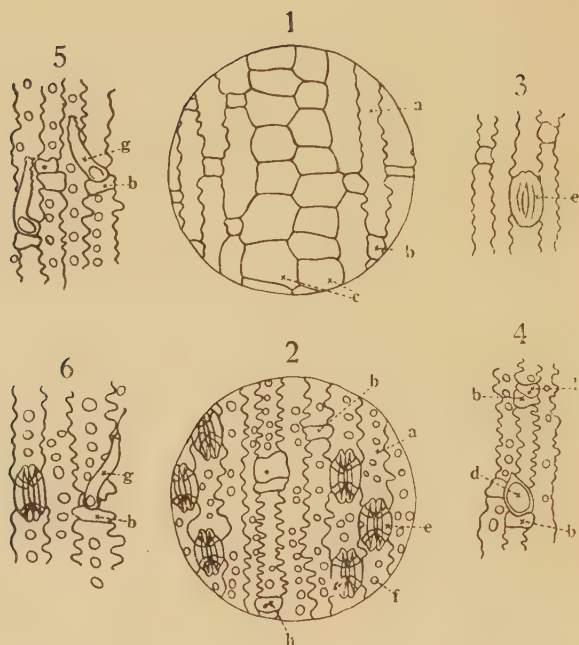
1. The number of cell rows constituting the band of articulation varies mostly 1-4, according to the distance from the midrib.
2. Spine cells are not found on the upper surface.
3. Haire and geniculate hairs are not found on the upper surface.
4. A very few spine cells and hairs are present on the under surface.
5. The walls of the geniculate hairs on the under surface are smooth or somewhat rough.

NOM. JAP. Shakotan-chiku.

HAB. Hokkaidō.

21. *Sasa kurilensis* MAKINO et SHIBATA (Fig. 18), in Bot. Mag. (Tokyo) XV. (1901) p. 27; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 149; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1495.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $16.6\text{--}119.5\ \mu$ long, $9.9\text{--}18.3\ \mu$ wide, two longer sides being strongly wavy, nearly parallel to the midrib, two other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on the shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $8.3\text{--}14.9\ \mu$ long, $9.9\text{--}16.6\ \mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}6.6\ \mu$ in length, $6.6\text{--}16.6\ \mu$ in breadth, their walls being flat, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands each of which consists of several cell rows nearly parallel to the midrib. Between the two bands just mentioned, there is found the band of articulation cells. The latter are nearly rectangular or polygonal in shape, about $13.3\text{--}16.6\ \mu$ in length, $13.3\text{--}16.6\ \mu$ in breadth, their walls being slightly undulate or flat. The number of cell rows constituting this band varies 1-3 or more,

Fig. 18. *Sasa kurilensis* MAKINO et SHIBATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (ap. x and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a stoma. 4. Portion of the under epidermis with a spine cell. 5-6. Portion of the under epidermis with 1 or 2 geniculate hairs. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein. \times ca. 194.

according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}72.7\ \mu$ in length, $8.3\text{--}33.2\ \mu$ in breadth, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $23.2\text{--}26.6\ \mu$ in length, few in number. No finger-like protuberance around the stomata exists on the upper surface. Hairs are 1-celled, very few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular or ovate in form, about $3.3\text{--}23.2\ \mu$ in length, $14.9\text{--}24.9\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the epidermis on the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24.9\text{--}66.4\ \mu$ in length, $8.3\text{--}24.9\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}28.2\ \mu$ in length, numerous in number, disposed mostly in 3–4 rows parallel to the veins. They are found in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. No hair. Geniculate hairs are 2-celled, the walls of their basal cells being slightly serrate or smooth, few in number, found on the epidermis above the assimilation tissue or rarely veins. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}23.2\ \mu$ in length, $16.6\text{--}23.2\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. Those belonging to the same row are separated from one another with the interval of about $3.3\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, it is necessary to pay attention to the following points:—

1. The number of cell rows consisting of the band of articulation cells varies 1–3 or more, according to the distance from the midrib.
2. A few spine cells and hairs are present on the upper surface.
3. Geniculate hairs are not found on the upper surface.
4. Hairs are not found on the under surface.
5. The walls of the geniculate hairs existing on the under surface are smooth or somewhat rough.

NOM. JAP. Chishima-zasa.

HAB. Hokkaidō.

22. *Sasa stenantha* NAKAI, in Journ. Arnold Arb. VI. (1925) p. 150.

a) *Epidermal cells constituting a greater part of the upper surface* are mostly longer rectangular cells. They are about $24.9\text{--}141.1\ \mu$ long,

8.3–16.6 μ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other shorter sides being slightly wavy or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell with or without a silica cell lying between the longer and the shorter. The shorter rectangular cells are about 4.9–8.3 μ long, 4.9–11.6 μ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 2.4–4.9 μ in length, 8.3–11.6 μ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands each of which consists of several cell rows parallel to the veins. Between two of these bands, there is found the band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, about 9.9–19.9 μ in length, 9.9–19.9 μ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the articulation band varies 1–5 or more, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 19.9–83 μ in length, 33.2 μ in breadth, very few in number, found only near the margin. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 19.9 μ in length, very few in number. No finger-like protuberance around the stomata exists on the upper surface. Neither ordinary hair nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about 3.3–24.9 μ in length, 11.6–24.9 μ in breadth, disposed in 1–3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about 1.6–166 μ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 19.9–33.2 μ in length, 8.3–9.9 μ in breadth, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 19.9–23.2 μ in length, numerous in number, disposed mostly in 3 rows nearly parallel to the veins. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular

cell. No hair. Genuiculate hairs are 2-celled, the walls of their basal cells being smooth or somewhat rough, very few in number. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}16.6\ \mu$ in length, $8.3\text{--}16.6\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, attention should be paid to the following points:—

1. The number of cell rows in the articulation band varies 1-5 or more, according to the distance from the midrib.
2. A few spine cells are present on both upper and under surface.
3. Hairs and genuiculate hairs are not found on the upper surface.
4. Hairs are not found on the under surface.
5. The walls of the genuiculate hairs on the under surface are smooth or somewhat rough.

NOM. JAP Me-kumazasa.

HAB. Honshū.

23. *Sasa nana* MAKINO (Fig. 19), in Bot. Mag. (Tokyo) XXVI. (1912) p. 13; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 149; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1495.

a) *Epidermal cells constituting the epidermis on the upper surface* are mostly longer rectangular cells. They are about $24.9\text{--}105\ \mu$ long, $8.3\text{--}19.9\ \mu$ wide, two longer sides being strongly wavy, nearly parallel to the midrib and the other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there is a small shorter rectangular cell with or without a silica cell which lies between the longer and the shorter. The shorter rectangular cells are about $2.4\text{--}19.9\ \mu$ long, $8.3\text{--}19.9\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}4.9\ \mu$ in length, $11.6\text{--}21.6\ \mu$ in breadth, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands each of which consists of several rows of cells nearly parallel to the midrib. Between the two bands just mentioned, there is the band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, about $8.3\text{--}21.6\ \mu$ in length, $6.6\text{--}13.3\ \mu$ in breadth, their walls being slightly wavy or flat. The number

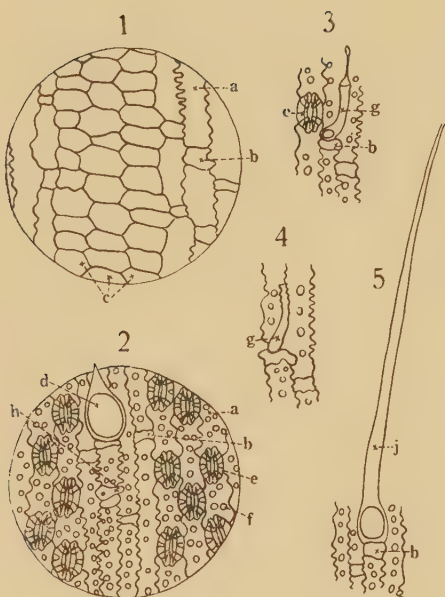


Fig. 19. *Sasa nana* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3-4. Portion of the under epidermis with a geniculate hair. 5. Portion of the under epidermis with an ordinary hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; j, ordinary hair. \times ca. 194.

of cell rows in this band is mostly 1-6, which varies according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6-44.8\mu$ in length, $16.6-24.9\mu$ in breadth, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are ovate, about 18.2μ in length, very few in number. No finger-like protuberance around stomata exists on the upper surface. Neither ordinary hair nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3-16.6\mu$ in length, $9.9-16.6\mu$ in breadth, disposed in 1-3 or more rows nearly parallel to the veins. Those belonging to the same row are arranged with the interval of about $1.6-166\mu$ or more.

b) *Epidermal cells constituting the under surface* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $28.2-29.9\mu$ in length, $9.9-16.6\mu$ in breadth, very few in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5-24.9\mu$ in length, numerous in number, disposed mostly in 3-4 rows parallel to the veins. These stomata belonging to

the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of the stoma so as to cover the latter. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly serrate, few in number. They exist on the epidermis above the assimilation tissue or the veins. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}16.6\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $3.3\text{--}16.6\ \mu$ or more.

To investigate of the spodogram of this species, attention should be paid to the following points:—

1. The number of cell rows consisting of a band of articulation cells are mostly 1–6, according to the distance from the midrib.
2. A few spine cells are found on the upper surface.
3. Hairs and geniculate hairs are not found on the upper surface.
4. A few silica cells are found in the epidermis above the assimilation tissue on the upper surface.
5. Hairs are found on the under surface.
6. The walls of the geniculate hairs on the under surface are smooth or somewhat rough.

NOM. JAP. Miyama-zasa.

Hab. Honshū.

24. *Sasa Tsuboiana* MAKINO (Fig. 20), in Bot. Mag. (Tokyo) XXVI. (1912) p. 23; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 150; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1496.

a) *Epidermal cells constituting a greater part of the upper surface* are mostly longer rectangular cells. They are about $36.5\text{--}124.5\ \mu$ long, $8.3\text{--}11.6\ \mu$ wide, two longer sides being remarkably wavy, nearly parallel to the midrib, the other shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, and on their shorter sides, there is a small shorter rectangular cell with or without a silica cell lying between the longer and the shorter. The shorter rectangular cells are about $6.6\text{--}8.3\ \mu$ long, $9.9\text{--}19.9\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $2.5\text{--}3.3\ \mu$ in length, $11.2\text{--}24.9\ \mu$ in breadth, numerous in number, their walls being flat. These cells of

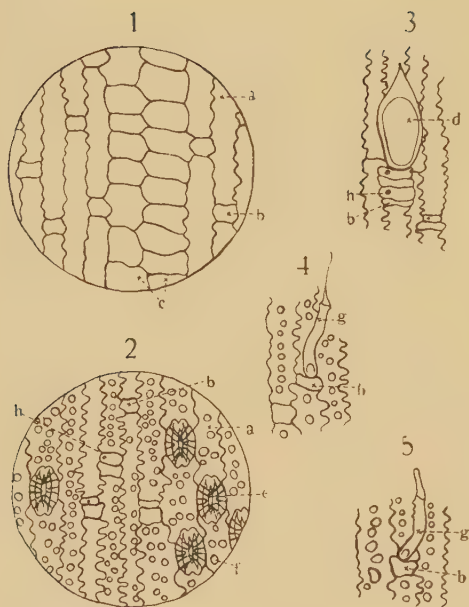


Fig. 20. *Sasa Tsuboia* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cell. 4-5. Portion of the under epidermis with geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell to be found in the epidermis on a vein. \times ca. 194.

the upper surface. Neither ordinary hair nor geniculate one. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. These cells are nearly rectangular or ovate in form, about $2.5-24.9 \mu$ in length, $11.6-23.2 \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $2.6-166 \mu$ or more.

b) *Epidermal cells constituting the under surface* resemble those of the upper surface, but they show some difference in the following points:—

three kinds, one longer, two shorter (one not containing silica and the other containing silica), make a number of bands each of which consists of several rows of cells parallel to the midrib. Between two bands, just mentioned, there is found a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, about $11.6-29.9 \mu$ in length, $11.6-16.6 \mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows in this band is mostly 1-5, which varies according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6-89.6 \mu$ in length, $9.9-33.2 \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about 24.9μ in length, very few in number. No finger-like protuberance around the stomata exists on

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24.9\text{--}37.2\ \mu$ in length, $11.2\text{--}16.6\ \mu$ in breadth, few in number. Viewed from a side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5\text{--}24.9\ \mu$ in length, numerous in number, disposed mostly in 3 rows in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, the walls of their basal cells being slightly serrate or smooth, comparatively numerous in number. They exist on the epidermis above the assimilation tissue or the veins. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $2.5\text{--}24.9\ \mu$ in length, $11.6\text{--}23.2\ \mu$ in breadth, disposed in 1-3 or more rows parallel to the veins. Those belonging to the same row are arranged with the interval of about $33.2\text{--}166\ \mu$ or more.

To investigate the spodogram of this species, attention should be paid to the following points:—

1. The number of cell rows constituting the band of articulation cells is mostly 1-5, which varies according to the distance from the midrib.
2. A few spine cells are present on the upper surface.
3. Hairs and geniculate hairs are not found on the upper surface.
4. Hairs are present on the under surface.
5. The walls of the geniculate hairs on the under surface are smooth or somewhat rough.
6. Many silica cells are found in the epidermis above the assimilation tissue on the upper surface.

NOM. JAP. Tsuboi-zasa, Ibuki-zasa.

HAB. Honshū

5. *Pseudosasa* MAKINO

MAKINO, Journ. Jap. Bot. II. (1920) p. 15; NAKAI, in
Journ. Arnold Arb. VI. (1925) p. 150; NEMOTO
and MAKINO, Fl. Jap. (1925) p. 1492.

As to the spodogram of the epidermis of the leaves, I have usually

observed it from above (i. e. from the outer side). The following descriptions of sporogon are taken from the preparations made from the middle portion of a leaf (i. e. nearly one inch square on both sides of the midrib). I have omitted those from both the basal and the apical portions.

A. General remarks

a) Epidermal cells constituting the upper surface of leaves are mostly longer rectangular cells. They are about $20.4\text{--}110\ \mu$ long, $8.5\text{--}17\ \mu$ wide, their two longer sides being remarkably wavy or slightly undulate or flat, nearly parallel to the midrib, the other shorter sides

being slightly wavy or flat, nearly perpendicular to the longer sides. Between any two longer rectangular cells, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3.5\text{--}10.2\ \mu$ long, $6.8\text{--}17\ \mu$ wide, their cell walls being slightly wavy or even. The silica cells are nearly rectangular in form, about $3.4\text{--}10.2\ \mu$ in length, $8.5\text{--}13.6\ \mu$ in breadth, their cell walls being even. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), compose a number of bands which consist of several cell rows, parallel to the veins. Between two bands of them, there exists a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, about $8.3\text{--}66.4\ \mu$ in length, $8.3\text{--}24.9\ \mu$ in breadth, their walls being wavy or flat. The number of cell rows constituting the band varies 1–4 or more, according to the distance

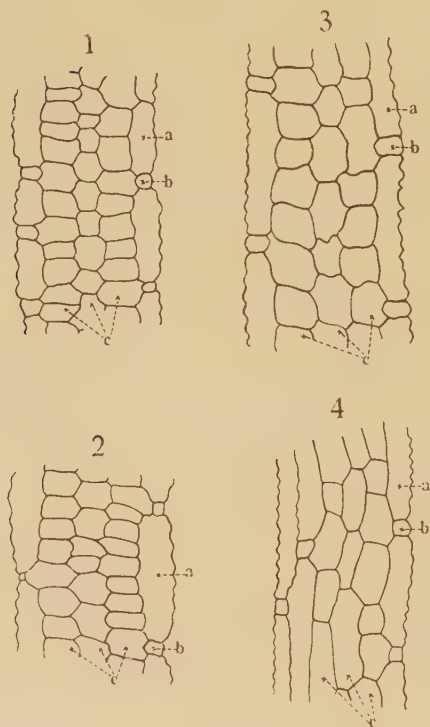


Fig. 21 Different aspects of articulation band in the different species of the genus, in the upper epidermis on one side of the midrib between two extremities (apex and base) of a leaf, seen from without.

1. *Pseudosasa Ocatarii* MAKINO; 2. *Ps. japonica* MAKINO; 3–4, *Ps. spiculosa* MAKINO. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells. \times ca. 194.

from the midrib. Spine cells, which are never found in *Pseudosasa spiculosa* MAKINO, are, however, very rarely found in other species, only on or near the margin. They are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15\text{--}150\ \mu$ in length, $18\text{--}51\ \mu$ in diameter. Viewed from the side, they are nearly rostrate in form, projecting a little above the surface. Stomata are nearly elliptical, about $22.1\text{--}26.6\ \mu$ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Neither ordinary hair nor geniculate one. Several silica cells containing especially large masses of silica are found or not found in the epidermis above the veins. They are nearly rectangular in form, about $5\text{--}10\ \mu$ in length, $3.4\text{--}22.1\ \mu$ in breadth, disposed in about 1–3 rows parallel to the veins, rarely piling on the shorter cells lying in the same row. These silica cells belonging to the same row are arranged with the interval of about $28.9\text{--}153\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $22.5\text{--}75\ \mu$ in length, $13.6\text{--}25.5\ \mu$ in diameter, numerous in number. A few protuberances are found or not found on the wall of these spine cells. Viewed from the side they are nearly rostrate in shape, projecting a little from the surface. Stomata are nearly elliptical, about $19.9\text{--}33.2\ \mu$ in length, very numerous in number, disposed mostly in 2–3 or more rows parallel to the veins. They are located in the epidermis above the assimilation tissue on both sides of a vein. These stomata which belong to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Hairs are found or not found. These hairs are 1-celled, their walls being smooth. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $5\text{--}17\ \mu$ in length, $9\text{--}25\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. These silica cells belonging to the same row are arranged with the interval of about $5\text{--}170\ \mu$ or more.

B. Key to the species

- 1 { Silica cells are found in the epidermis above the veins on the upper surface of leaves. Geniculate hairs are not present on the epidermis above the veins on the under surface of leaves. 2
- 1 { Silica cells are nearly absent in the epidermis above the veins on the upper surface of leaves. A few geniculate hairs are found on the epidermis above the veins on the under surface of leaves . . . 25. *Pseudosasa Ōwatarii* MAKINO
- 2 { Silica cells existing in the epidermis above the veins on the upper surface are comparatively numerous and are in contact with the small shorter cells 26. *Ps. japonica* MAKINO
- 2 { Silica cells existing in the epidermis above the veins on the upper surface are few in number and are rarely laid on the small shorter cells 27. *Ps. spiculosa* MAKINO

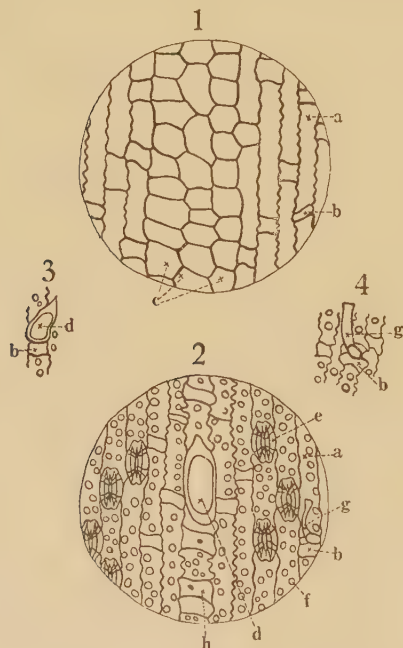


Fig. 22. *Pseudosasa Ōwatarii* MAKINO
1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with a spine cell with waved walls. 4. Portion of the under epidermis on a vein with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein. x ca. 194.

C. Descriptions

25. *Pseudosasa Ōwatarii* MAKINO (Fig. 22), Journ. Jap. Bot. II. (1920) p. 16; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 150; NEMOTO and MAKINO, l. c.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $20.4-68\mu$ long, $8.5-17\mu$ wide, their two longer sides being remarkably wavy, parallel to the midrib, and the other shorter sides being straight or slightly undulate, nearly perpendicular to the longer sides. Between any two longer rectangular cells, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter cells. These shorter cells are very small in size and measure about $3.4-10.2\mu$ long, $8.5-17\mu$ wide, their cell walls being slightly wavy or even. The silica cells are nearly rectangular in form, about $3.4-6.8\mu$

in length, $8.5-11.9\ \mu$ in breadth, few in number. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), compose a number of bands which consist of several cell rows parallel to the veins. Between two of these bands, there is found a band of articulation cells. The latter cells are polygonal in shape, about $8.3-16.6\ \mu$ in length, $13.3-19.9\ \mu$ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the band varies 1-8 or more, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $170\ \mu$ in length, $50\ \mu$ in diameter, found only near the margin, very few in number. Stomata are nearly elliptical, about $20.4\ \mu$ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Neither ordinary hairs nor geniculate ones. Several silica cells containing especially large masses of silica are not nearly found in the epidermis above the veins.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at apex, about $27-51\ \mu$ in length, $13.6-17\ \mu$ in diameter, very numerous in number. A few protuberances are rarely found on the wall of these spine cells. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $22.1-25.5\ \mu$ in length, very numerous in number, disposed mostly in 2-4 rows parallel to the veins. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells and incline towards the center of stomata. Hairs are 1-celled, their walls being smooth, very few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They exist in the epidermis above the veins or the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $5-8.5\ \mu$ in length, $9-17\ \mu$ in breadth, disposed in 1 or more rows parallel to the veins. These silica cells

belonging to the same row are arranged with the interval of 5–170 μ or more.

The following points may be mentioned as worthy of attention for the study of the spodogram of this species :—

1. Spine cells are only found at the parts near the margin on the upper surface of leaves.
2. Silica cells are hardly seen in the epidermis above the veins on the upper surface of leaves.
3. Stomata are disposed above the assimilation tissue on both sides of the veins, in 2–3 or rarely 4 rows, and sometimes they are found in all cell-rows existing between two veins on the under surface of leaves.
4. Spine cells on the under surface of leaves have rarely on one side or both sides one or more papillae, which are sometimes reduced to such a degree that their walls are slightly wavy.
5. Geniculate hairs are found on the epidermis above the veins as well as on the assimilation tissue.

NOM. JAP. Yakushima-dake.

HOB. Kyushū : Yakushima ins.

29. *Pseudosasa japonica* MAKINO (Fig. 23), Journ. Jap. Bot. II. (1920) p. 15 ; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 150 ; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1492.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. These cells are about 42–110 μ long, 15–17 μ wide, with two longer sides being parallel to the midrib, being slightly wavy, two other sides nearly perpendicular to the former, being slightly undulate or straight. Between any two longer rectangular cells, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter cells are about 6–9 μ long, 6.8–15.3 μ wide, the walls being nearly flat. The silica cells are nearly rectangular in form, about 5 μ in length, 13.6 μ in breadth, comparatively few in number. These cells of three kinds, of which one is longer, two are shorter (one with silica and the other without silica), compose a number of bands which consist of several cell rows parallel to the midrib. Between two bands of them, there is found a band of articulation cells. The latter cells are polygonal or nearly rectangular in shape, about 8.3–24.9 μ in length, 8.3–24.9 μ in breadth, their walls being slightly wavy or flat. The number of cell rows constituting the band varies 1–4 or more, according to the distance from the midrib. Spine cells are nearly elliptical, rounded at the base, cuspidate

or acute at the apex, about $76.5\text{--}153\ \mu$ in length, $42\text{--}51\ \mu$ in diameter, few in number, found only near the margin. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $22.1\text{--}26.6\ \mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Neither ordinary hairs nor geniculate ones. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. These cells are nearly rectangular in form, about $5\text{--}11.6\ \mu$ in length, $13.6\text{--}22.1\ \mu$ in breadth, disposed in about 1–3 rows parallel to the veins. These silica cells which belong to the same row are arranged with the interval of about $28.9\text{--}153\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* resemble those of the upper surface, but they show some difference in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $34\text{--}70\ \mu$ in length, $17\text{--}25.5\ \mu$ in diameter, very numerous in number. Some have one or more protuberances on either side. Viewed from the side, they are rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6\text{--}26.6\ \mu$

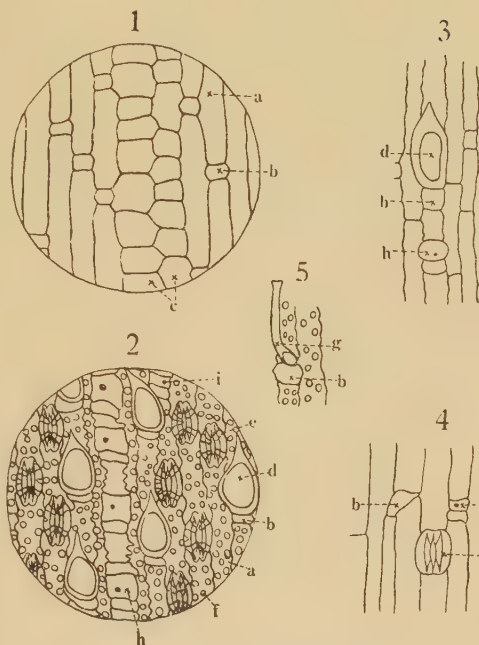


Fig. 23. *Pseudosasa japonica* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis on a vein with a spine cell and a silica cell. 4. Portion of the upper epidermis with a stoma. 5. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cell; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell as found in the epidermis on a vein; i, silica cell in the epidermis on the assimilation cell. \times ca. 194.

in length, numerous in number, disposed mostly in 3-4 rows in the epidermis above the assimilation tissue existing on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from epidermal cells adjoining to the guard cells and incline towards the center of stomata. Hairs are not found. Genuiculate hairs are 2-celled, their walls being smooth, comparatively numerous in number. They are found on the epidermis above the assimilation tissue. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are rectangular in form, about $8.5-17\ \mu$ in length, $11.9-25\ \mu$ in breadth, disposed in 1-3 rows parallel to the veins. Those which belong to the same row are arranged with the interval of $8.3-165\ \mu$ or more.

For the investigation of the spodogram of this species, it is necessary to pay attention to the following points:—

1. Silica cells are found on the epidermis above the veins on the upper surface of leaves.
2. Some of spine cells which are found on the under surface of leaves have a few protuberances on their walls on either one side or both sides.
3. Genuiculate hairs are present only on the epidermis above the assimilation tissue on the under surface of leaves.

NOM. JAP. Ya-dake.

HAB. Honshū, Shikoku, Kyushū.

27. *Pseudosasa spiculosa* MAKINO (Fig. 24), Journ. Jap. Bot. II. (1920) p. 16; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1492.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $37.5-110\ \mu$ long, $8.5-17\ \mu$ wide, their longer sides being strongly wavy and parallel to the midrib, their shorter sides being slightly wavy or straight and nearly perpendicular to the veins. Between any two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell which lies between the longer and the shorter. The shorter cells are about $6.8-10.2\ \mu$ long, $8.5-17\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $8.5-10.2\ \mu$ in length, $3.4-5.1\ \mu$ in breadth, few in number. These cells of three kinds, one longer, two shorter (one not containing silica and the other containing silica), make a number of bands which consist of several rows of cells parallel to the midrib. Between any two

bands just mentioned, there is found a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being slightly undulate or straight. The number of cell rows in this band is mostly 1-5, which varies according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the length of the articulation cells in the middle row is remarkably longer than their width. They are about $11.6-66.4\mu$ long, $11.6-19.9\mu$ wide, and those in the lateral rows are about $16.6-33.2\mu$ long, $11.6-16.6\mu$ wide. They have neither spine cell, nor ordinary hair, nor geniculate ones. Stomata are nearly elliptical, about 24.9μ in length, few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. A few silica cells are rarely found in the epidermis above the veins. They are nearly rectangular in form, about $4.9-8.5\mu$ in length, $3.4-8.3\mu$ in breadth, rarely piled on the shorter cells lying in the same row.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $25.5-75\mu$ in length, $17-25.5\mu$ in diameter, very numerous in number. A few protuberances are found or not found on the wall of these spine cells. Viewed from the side they are rostrate in shape, projecting a little above the surface. Stomata are nearly

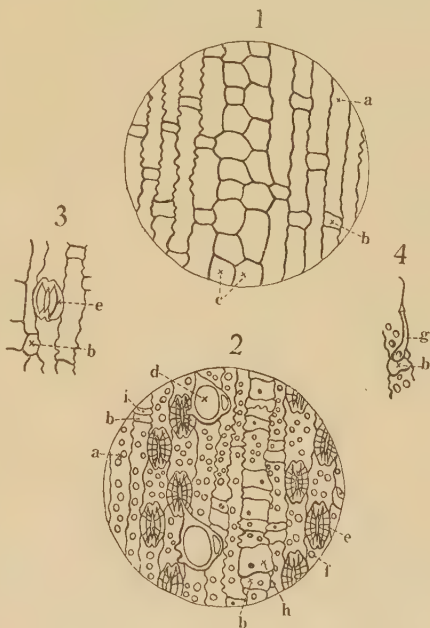


Fig. 24. *Pseudosasa spiculosa* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with stoma. 4. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

elliptical, about $19.9\text{--}33.2\mu$ in length, numerous in number, disposed in 2–3 rows parallel to the veins. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. No hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They exist on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaves. Several silica cells containing especially large masses of silica are found on the epidermis above the veins. They are nearly rectangular in form, about $5\text{--}17\mu$ in length, $10.2\text{--}17\mu$ in breadth, disposed in 1–3 more rows parallel to the veins. These silica cells which belong to the same row are arranged with the interval of about $5\text{--}170\mu$ or more.

As to the features of the spodogram of this species, the following few points are worthy of attention:—

1. Silica cells which are found on the epidermis above the veins on the upper surface are seldom to be seen in piling upon the shorter cells.
2. Stomata on the under surface are disposed mostly in 2–3 rows on both sides of veins in the epidermis above the assimilation tissue.
3. Some of spine cells to be found on the under surface have one or more protuberances at their walls.
4. Geniculate hairs on the under surface exist exclusively on the epidermis above the assimilation tissue.

NOM. JAP. Suzu-dake.

HAB. Honshū, Shikoku.

6. *Sasaella* MAKINO

MAKINO, Journ. Jap. Bot. VI. (1929) p. 15.

As to the spodogram of the epidermis of the leaves, I have usually observed it from above (i. e. from the outer side). The following descriptions of spodogram are taken from the preparations made from the middle portion of a leaf (i. e. nearly one inch square on both sides of the midrib). I have omitted those from both the basal and the apical portions.

A. General remarks

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about 14.9–141.1 μ long, 8.3–24.9 μ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell, between a longer cell and itself. These shorter rectangular cells are about 3.3–9.9 μ long, 6.6–16.6 μ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about 1.6–6.6 μ in length, 9.9–13.3 μ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between two bands of them, there exists the band of articulation cells. The latter cells nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting this band varies 1–6, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about 11.6–33.2 μ long, 11.6–21.6 μ wide, and those in the lateral rows are about 11.6–33.2 μ long, 11.6–21.6 μ wide. Spine cells are present or absent. They are when present, nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 13.3–81.3 μ in length, 8.3–24.9 μ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about 23.2–24.9 μ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Hairs are found or not found. They are 1-celled, few or comparatively numerous in number. Geniculate hairs exist or not exist. They are 2-celled, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form about 4.9–18.3 μ in length, 14.9–26.6 μ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about 3.3–166 μ or more.

b) *Epidermal cells constituting the under surface of leaves*, nearly

resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $14.9\text{--}58.1\ \mu$ in length, $9.9\text{--}28.2\ \mu$ in diameter, few or numerous in number. Viewed from the side, they are nearly

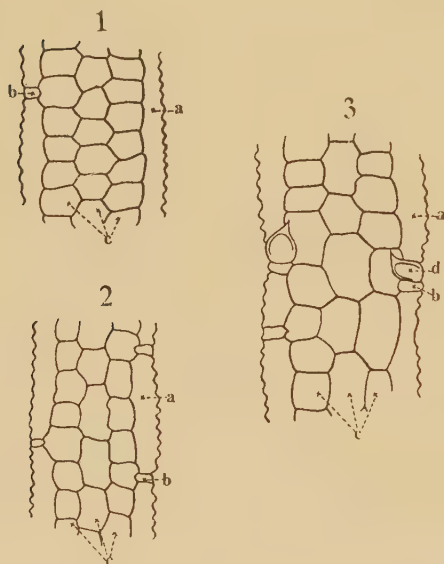


Fig. 25. A portion¹ of the articulation band in the upper epidermis on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 1-2. *Sasaella Hisauchi* MAKINO; 3. *Sasa* *hannensis* MAKINO. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell. \times ca. 216.

rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $20.4\text{--}27.2\ \mu$ in length, very numerous in number, disposed mostly in 2-4 rows, nearly parallel to a vein. They exist in the epidermis above the assimilation tissue located on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center so as to close the stomata. Hairs are found or not found. They are 1-celled, few in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth

or rarely scabrous, few in number. Protuberances on the epidermal cells are found everywhere. They are seen existing exclusively on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}21.6\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed in 1-3 or more rows, nearly parallel to a vein. Those which belong to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

B. Key to the species

- 1 { Neither spine cell nor ordinary hair on the upper surface of leaves
 28. *Sasaella Hisauchii* MAKINO
 { Spine cells and ordinary hairs are found on the upper surface of leaves 2
- 2 { Geniculate hairs are found on the upper surface of leaves.
 29. *Sasacl. ramosa* MAKINO
 { Geniculate hairs are not found on the upper surface of leaves
 30. *Sasacl. hannoensis* MAKINO

C. Descriptions

28. *Sasaella Hisauchii* MAKINO, Jouru. Jap. Bot. VI. (1929) p. 15.

Syn. *Sasa Hisauchii* MAKINO, l. c. III. (1926) p. 22.

Pseudosasa Hisauchii MAKINO, l. c. V. (1928) p. 16.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $14.9\text{--}132.8\ \mu$ long, $8.3\text{--}16.6\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell which lies between the longer and the shorter cells. The shorter rectangular cells are about $4.9\text{--}9.9\ \mu$ long, $6.6\text{--}14.9\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $1.6\text{--}4.9\ \mu$ in length, $9.9\text{--}13.3\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows parallel to the midrib. Between two bands of them, there is found a band of articulation cells. The same cells are nearly rectangular or polygonal in shape, their walls being slightly wavy or even. The number of cell rows making up the band varies about 2–7, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $11.6\text{--}24.9\ \mu$ long, $13.3\text{--}21.5\ \mu$ wide, and those in the lateral rows are about $11.6\text{--}16.6\ \mu$ long, $16.6\text{--}21.6\ \mu$ wide. No spine cell. Neither ordinary hair nor geniculate hair. Stomata are scarcely found. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}9.9\ \mu$ in length, $14.9\text{--}19.9\ \mu$ in breadth, disposed mostly in 1–2 rows

parallel to the veins. Those belonging to the same row are arranged with the interval of about $16.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble in general those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}30.2\ \mu$ in length, $9.9\text{--}16.6\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $26.6\text{--}28.3\ \mu$ in length, very numerous in number, disposed mostly in 3–4 rows, nearly parallel to a vein. They are located in the epidermis above the assimilation tissue existing on both sides of a vein. These stomata which belong to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. No hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}16.6\ \mu$ in length, $11.6\text{--}18.3\ \mu$ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. These silica cells which belong to the same row are arranged with the interval of about $1.6\text{--}149.4\ \mu$ or more.

To study the spodogram of this species, attention should be paid to the following points:—

1. Neither spine cell nor ordinary hair on the upper surface of leaves.
2. The walls of the geniculate hairs existing on the under surface are smooth.

NOM. JAP. Hime-suzudake.

HAB. Honshū.

29. *Sasaella ramosa* MAKINO (Fig. 26), Journ. Jap. Bot. VI. (1929) p. 15.

Syn. *Sasa ramosa* MAKINO et SHIBATA, in Bot. Mag. (Tokyo) XV. (1901) p. 24; MATSUMURA, Index Pl. Jap. II. (1905) p. 97; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 150; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1496.

a) *Epidermal cells constituting the upper surface of leaves* are mostly

longer rectangular cells. These cells are about $49.8\text{--}141.1\ \mu$ long, $8.3\text{--}19.9\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly wavy or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3.3\text{--}8.3\ \mu$ long, $6.6\text{--}14.9\ \mu$ wide, their walls being slightly wavy or even. The silica cells are nearly rectangular in form, about $3.3\text{--}6.6\ \mu$ in length, $11.6\text{--}13.3\ \mu$ in breadth, their walls being even. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows parallel to the midrib. Between any two bands of them, there is found a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being wavy or even. The number of cell rows constituting the band varies 2-5, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $16.6\text{--}33.2\ \mu$ long, $13.3\text{--}16.6\ \mu$ wide, and those in the lateral rows are about $13.3\text{--}29.9\ \mu$ long, $13.3\text{--}16.6\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.6\text{--}81.3\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in diameter, very numerous in number. Viewed from the side they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical or ovate, about $23.2\text{--}24.9\ \mu$ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $14.9\text{--}18.3\ \mu$ in length, $14.9\text{--}26.6\ \mu$ in breadth, disposed mostly in 1-3 rows, nearly parallel to the veins. Those which belong to the same row are arranged with the interval of about $6.6\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $14.9\text{--}31.5\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $23.2\text{--}28.2\ \mu$ in length, numerous in number, disposed in 3-4

rows or more, parallel to the veins. They are found in the epidermis above the assimilation tissue existing on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or rarely slightly scabrous, few in number. They are found mostly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are seen existing only on the under surface of leaves. Several silica cells containing especially large masses of silica are

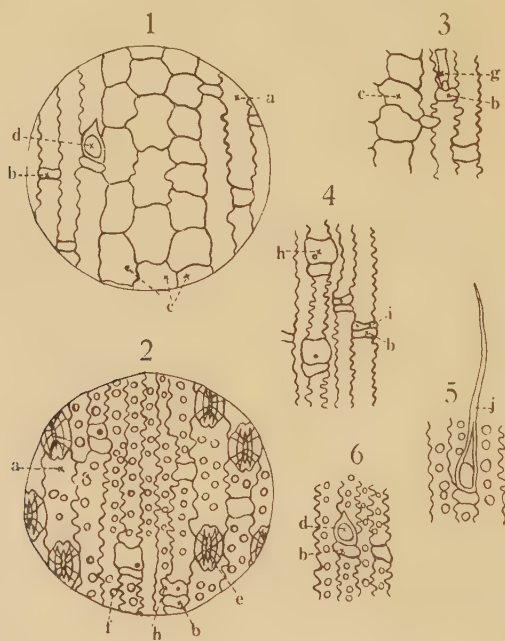


Fig. 26. *Sasaella ramosa* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a geniculate hair. 4. Portion of the upper epidermis on a vein. 5. Portion of the under epidermis with an ordinary hair. 6. Portion of the under epidermis with a spine cell. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}21.6\ \mu$ in length, $11.6\text{--}16.6\ \mu$ in breadth, disposed in 1–3 or more rows parallel to the veins. Those which belong to the same row are arranged with the interval of about $1.6\text{--}16.6\ \mu$ or more.

To study the spodogram of this species, it is necessary to pay attention to the following points:—

1. Spine cells, ordinary hairs and geniculate ones are found on the upper surface of leaves.
2. Ordinary hairs are found on the under surface of leaves.
3. The walls of the basal cells of the geniculate hairs existing on the under surface of leaves are smooth or rarely scabrous.

NOM. JAP. Azuma-zasa.

HAB. Honshū.

30. *Sasaella hannoensis* MAKINO (Fig. 27), Journ. Jap. Bot. VI. (1929) p. 15.

Syn. *Sasa hannoensis* MAKINO, l. c. III. (1926) p. 16.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $35.5\text{--}124.5\ \mu$ long, $8.3\text{--}24.9\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or flat, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell which lies between the longer and the shorter. The shorter rectangular cells are about $4.9\ \mu$ long, $8.3\text{--}16.6\ \mu$ wide, their walls being slightly undulate or even. The silica cells are nearly rectangular in form, about $1.6\text{--}3.3\ \mu$ in length, $13.3\ \mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows parallel to the veins. Between any two bands of them, there is found a band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies 1–5, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $13.3\text{--}33.2\ \mu$ long, $11.6\text{--}16.6\ \mu$ wide, and those in the lateral rows are about $13.3\text{--}33.2\ \mu$ long, $11.6\text{--}16.6\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $13.3\text{--}66.4\ \mu$ in length, $8.3\text{--}24.9\ \mu$ in diameter, very numerous in number. Viewed from the

side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 23.2μ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Hairs are 1-celled, comparatively numerous in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are rectangular in form, about $4.9\text{--}16.6\mu$ in length, $14.9\text{--}19.9\mu$ in breadth, disposed in 1-3 or more rows parallel to a vein. Those which belong to the same row are arranged with the interval of about $3.3\text{--}166\mu$ or more.

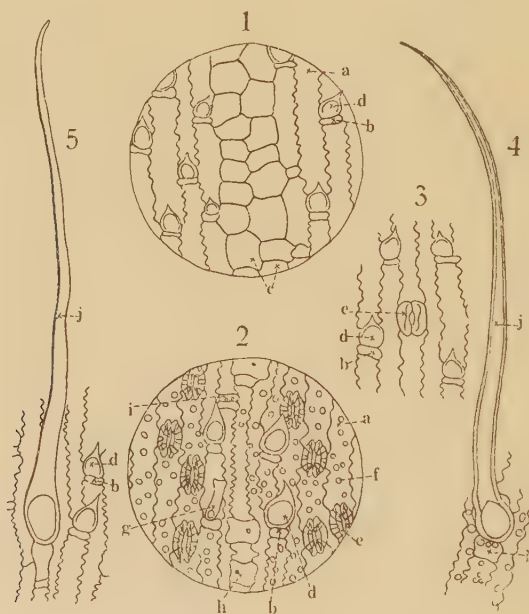


Fig. 27. *Sasaella hannoensis* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a stoma and spine cells. 4. Portion of the under epidermis with an ordinary hair. 5. Portion of the upper epidermis with an ordinary hair and spine cells. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but they show some differences in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $18.2\text{--}58.1\ \mu$ in length, $9.9\text{--}28.2\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $23.2\text{--}24.9\ \mu$ in length, numerous in number, disposed in mostly 2–5 rows, nearly parallel to a vein. They exist in the epidermis above the assimilation tissue located on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Hairs are 1-celled, numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number, found on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}19.9\ \mu$ in length, $11.6\text{--}24.9\ \mu$ in breadth, disposed in 1–3 or more rows, parallel to the veins. Those which belong to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

The following points may be mentioned as worthy of attention:—

1. Spine cells and ordinary hairs are found on the upper surface of the leaves.
2. Geniculate hairs are not found on the upper surface of the leaves.
3. The walls of the geniculate hairs existing on the under surface of the leaves are smooth.

NOM. Jap. Hannō-zasa.

HAB. Honshū.

7. *Semiarundinaria* MAKINO

MAKINO, Journ. Jap. Bot. II. (1918) p. 7; NAKAI, in Journ.

Arnold Arb. VI. (1925) p. 150; NEMOTO and

MAKINO, Fl. Jap. (1925) p. 1405.

31. *Semiarundinaria fastuosa* MAKINO (Fig. 28), l. c. p. 8; NAKAI, l. c. p. 151; NEMOTO and MAKINO, l. c. p. 1497.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $50.8\text{--}100\ \mu$ long, $6.6\text{--}16.6\ \mu$

wide, their two longer sides being undulate, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and in contact with their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $4.9\text{--}8.3\ \mu$ long, $6.6\text{--}16.6\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\ \mu$ in length, $11.7\ \mu$ in breadth, their walls being flat, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two bands of them, there exists the band of articulation cells. The articulation cells are nearly rectangular or polygonal in shape, their walls being very slightly wavy or flat. The number of cell rows constituting the band varies mostly 2-3, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $13.3\text{--}41.5\ \mu$ long, $11.6\text{--}24.9\ \mu$ wide, and those in the lateral rows are about $19.9\text{--}33.2\ \mu$ long, $11.6\text{--}26.5\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, acute or cuspidate at the apex, about $16.6\text{--}46.5\ \mu$ in length, $13.2\text{--}23.3\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\ \mu$ in length, few in number. No finger-like protuberance exists around stomata on the upper surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}20\ \mu$ in length, $16.6\text{--}24.9\ \mu$ in breadth, disposed mostly in a row nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.6\text{--}166\ \mu$ or more.

b) Epidermal cells constituting the under surface of leaves nearly resemble those of the upper surface, but differ in the following points :—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24.9\text{--}66.4\ \mu$ in length, $16.6\text{--}24.9\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.5\text{--}26.6\ \mu$ in length, very numerous in number, disposed mostly in 2-4 rows nearly parallel to a vein. They exist in the epidermis above the assimilation tissue on both sides of a vein.

Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are mainly found on the epidermis above the assimilation tissue. Protuberances are found everywhere. They exist only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}16.6\mu$ in length, $14.9\text{--}28.2\mu$ in breadth, disposed mostly in 1–3 rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $1.6\text{--}66.4\mu$.

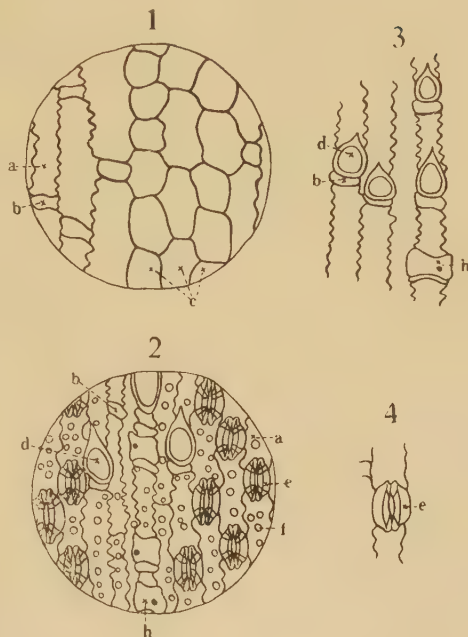


Fig. 28. *Semiarundinaria fastuosa* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) on a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells. 4. Portion of the upper epidermis with a stoma. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein. \times ca. 194.

The following points are worthy of attention:—

1. The number of cell rows constituting the articulation band varies 2–3, according to the distance from the midrib.
2. Silica corpuscles are found few in number, or not at all, in the articulation cells.
3. When the articulation band consists of 3 cell-rows, the cells in the middle row are mostly about $13.3\text{--}41.5\mu$ long, $11.6\text{--}24.9\mu$ wide, and those in the lateral rows are mostly about $19.9\text{--}33.2\mu$ long, $11.6\text{--}26.5\mu$ wide.

NOM. JAP. Narihira-dake.

HAB. Shikoku, Kyushū.

8. *Sinobambusa* MAKINO

MAKINO, Journ. Jap. Bot. II. (1918) p. 8; NAKAI, in Journ. Arnold Arb. VI. (1925) p. 152.

32. *Sinobambusa* Tootsik MAKINO, l. c.; NAKAI l. c.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $29.9\text{--}102.9\mu$ long, $8.3\text{--}13.3\mu$ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $4.9\text{--}8.3\mu$ long, $9.9\text{--}16.6\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3\text{--}8.3\mu$ in length, $9.9\text{--}13.3\mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two bands of them, there exists the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being flat or seldom undulate. They contain many silica corpuscles. The number of cell rows constituting the band varies 2–4 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $13.3\text{--}31.5\mu$ long, $8.3\text{--}13.3\mu$ wide, and those in the lateral rows are about $8.3\text{--}28.2\mu$ long, $13.3\text{--}19.9\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $11.6\text{--}13.3\mu$ in length, $8.3\text{--}11.6\mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6\text{--}24.9\mu$ in length, few in number. No finger-like protuberance comes forth from the epidermal cells adjoining to the guard cells. Ordinary hairs are 1-celled, very few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\mu$ in length, $9.9\text{--}13.3\mu$ in breadth, disposed mostly in 1–2 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $13.3\text{--}166\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly

resemble those of the upper surface, but differ in the following points :—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $28.3\text{--}46.5\ \mu$ in length, $11.6\text{--}21.6\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $28.3\text{--}33.2\ \mu$ in length, disposed mostly in 2–3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue existing on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Genuiculate hairs are 2-celled, their walls being smooth, few in number. They are found mainly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells exist everywhere. They are only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}9.9\ \mu$ in length, $8.3\text{--}14.9\ \mu$ in breadth, disposed mostly in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.6\text{--}107.9\ \mu$.

The following points are worthy of mention :—

1. Genuiculate hairs are not found on the upper surface of leaves.
2. Stomata in the epidermis on the under surface are about $28.3\text{--}33\ \mu$ or more in length.
3. Silica cells in the upper epidermis less than $10\ \mu$ in length.
4. Ordinary hairs are found very few in number on the upper surface of the leaves.

NOM. JAP. Tootsik.

HAB. Japan, cultivated.

9. *Chimonobambusa* MAKINO

MAKINO, in Bot. Mag. (Tokyo) XXVIII. (1914) p. 153 ;

NAKAI, in Journ. Arnold Arb. VI. (1925) p. 151.

33. *Chimonobambusa quadrangularis* MAKINO, l. c.; NAKAI, l. c.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $26.6\text{--}93\ \mu$ long, $8.3\text{--}19.9\ \mu$ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two

longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $6.6\text{--}8.3\ \mu$ long, $9.9\text{--}16.6\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $1.6\text{--}6.6\ \mu$ in length, $8.3\text{--}9.9\ \mu$ in breadth, their walls being flat. Silica corpuscles (Kieselkörper) are not found in the longer and shorter rectangular cells. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two bands of them, there exists the band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being slightly undulate or flat. They contain usually many silica corpuscles. The number of cell rows constituting the band varies mostly 2-3, according to the distance from the midrib. When the articulation bands consist of 3 cell-rows, the articulation cells in the middle row are about $14.9\text{--}29.9\ \mu$ long, $6.6\text{--}9.9\ \mu$ wide, and those in the lateral rows are about $13.3\text{--}24.9\ \mu$ long, $8.3\text{--}11.6\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $8.3\text{--}11.6\ \mu$ in length, $8.3\text{--}11.6\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $18.3\text{--}23.2\ \mu$ in length, very few in number. No finger-like protuberance exists around stomata on the upper surface. Neither ordinary nor geniculate hair. A few silica cells are seldom found in the epidermis above the veins. They are nearly rectangular in form, about $2.5\text{--}4.9\ \mu$ in length, $8.3\text{--}11.6\ \mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are separated from one another with the interval of about $91.3\text{--}166\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21.6\text{--}49.9\ \mu$ in length, $9.9\text{--}16.6\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}29.9\ \mu$ in length, numerous in number, disposed mostly in 3-4 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come

forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found on the epidermis above the assimilation tissue or rarely on that of veins. Protuberances are found everywhere. They exist only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}9.9\mu$ in length, $8.3\text{--}13.3\mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $1.6\text{--}166\mu$ or more.

The following points are worth mentioning:—

1. Silica cells in the upper epidermis above the veins are mostly less than 10μ in length.
2. Ordinary and geniculate hairs do not exist on the upper surface of leaves.

NOM. JAP. Shikaku-dake.

HAB. Japan, cultivated.

10. *Pleioblastus* NAKAI

NAKAI, in Journ. Arnold Arb.

VI. (1925) p. 145.

As to the spodogram of the epidermis of the leaves, I have usually observed it from above (i. e. from the outer side). The following descriptions of spodogram are taken from the preparations made from the middle portion of a leaf (i. e. nearly an inch square on both sides of the midrib). I have omitted those from both the basal and the apical portions.

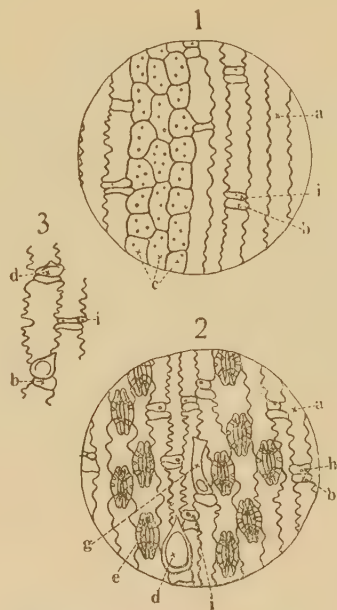


Fig. 29. *Chimonobambusa quadrangularis* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

A. General remarks

a) *Epidermal cells on a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $15-150\ \mu$ long, $4-24\ \mu$ wide, their two longer sides being strongly wavy or slightly undulate, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and on their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-12\ \mu$ long, $4-15\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3-6\ \mu$ in length, $7.5-15\ \mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of

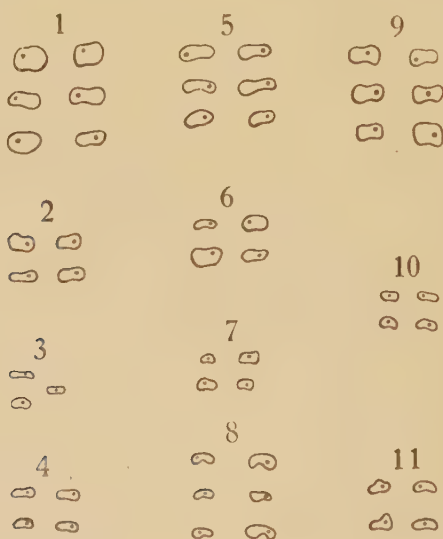


Fig. 30. Different kinds of silica cells in the different species of the genus in the upper epidermis above the veins. They are taken from the upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 1. *Pleioblastus linearis* NAKAI; 2. *Pl. communis* NAKAI; 3. *Pl. Usawai* (HAYATA) OHKI; 4. *Pl. Kunishii* (HAYATA) OHKI; 5. *Pl. yamakitensis* MAKINO; 6. *Pl. variegata* MAKINO; 7. *Pl. oiwakensis* (HAYATA) OHKI; 8. *Pl. Simoni* NAKAI; 9. *Pl. Chino* MAKINO; 10. *Pl. niitakayamensis* (HAYATA) OHKI; 11. *Pl. gramineus* NAKAI \times ca. 216.

several cell rows nearly parallel to the veins. Between any two bands of them, there is found a band of articulation cells. These cells are polygonal or nearly rectangular in shape, their walls being wavy or flat. The number of cell rows constituting this band varies 1-4 or more rows, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $6.6-49.8\ \mu$ long, $3.3-16.6\ \mu$ wide, and those in the lateral rows are about $8.3-24.9\ \mu$ long, $4.9-16.6\ \mu$ wide. Some species have the spine cells, but others have not. These spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $12-150\ \mu$ in length, $7-45\ \mu$ in diameter, few or numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, $18-30\ \mu$ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. Hairs are found or not found. They are 1-celled, few in number. Genuiculate hairs exist or not exist. They are 2-celled, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3-15\ \mu$ in length, $9-21\ \mu$ in breadth, disposed in 1-5 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $3-150\ \mu$ or more.

b) *Epidermal cell constituting the under surface of leaves* nearly resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical or ovate, rounded at the base, cuspidate or acute at the apex, about $15-60\ \mu$ in length, $9-21\ \mu$ in diameter, few or numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $14.9-29.9\ \mu$ in length, very numerous in number, disposed mostly in 1-5 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Hairs are found or not found. They are 1-celled, few in number. Genuiculate hairs are 2-celled, the walls of their basal cells being smooth or slightly scabrous, few or comparatively numerous in number.

Protuberances on the epidermal cells are seen everywhere. They are found existing only on the under surface of leaves. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about 3–21 μ in length, 6–17 μ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about 1.6–150 μ or more.

B. Key to the species

- 1 { Geniculate hairs are found on the upper surface of leaves 2
- 1 { Geniculate hairs are not found on the upper surface of leaves 6
- 2 { Hairs are found on the upper surface of leaves 4
- 2 { Hairs are not found on the upper surface of leaves 3
- 3 { When an articulation band consists of 3 cell-rows, the articulation cells in the middle row are generally 3.3–6.6 μ wide. The walls of the basal cells of geniculate hairs existing on the under surface are smooth or slightly scabrous 34. *Pleioblastus linearis* NAKAI
- 3 { When an articulation band consists of 3 cell-rows, the articulation cells in the middle row are generally 9.9–14.9 μ wide. The walls of the basal cells of geniculate hairs existing on the under surface are smooth 35. *Pl. communis* NAKAI
- 4 { Hairs are found on the under surface of leaves . 36. *Pl. Usawai* (HAYATA) OHKI
- 4 { Hairs are not found on the under surface of leaves 5
- 5 { A few spine cells are found on the upper surface of leaves. The walls of the basal cells of geniculate hairs existing on the under surface are smooth or slightly scabrous. Stomata in the epidermis on the under surface are shorter than 25 μ in length 37. *Pl. Kunishii* (HAYATA) OHKI
- 5 { Numerous spine cells are found on the upper surface of leaves. The walls of the basal cells of geniculate hairs on the under surface are smooth. Some of stomata existing in the epidermis on the under surface are 25 μ or over in length 38. *Pl. yamaleitensis* MAKINO
- 6 { Spine cells are found on the upper surface of leaves 7
- 6 { Spine cells are not found on the upper surface of leaves 10
- 7 { Hairs are found on the upper surface of leaves . . . 39. *Pl. variegata* MAKINO
- 7 { Hairs are not found on the upper surface of leaves 8
- 8 { The walls of the geniculate hairs existing on the under surface are smooth 40. *Pl. oiwakensis* (HAYATA) OHKI
- 8 { The walls of the geniculate hairs existing on the under surface are smooth or slightly scabrous 9
- 9 { Stomata existing in the epidermis on the under surface are shorter than 25 μ in length 41. *Pl. Simoi* NAKAI
- 9 { Some stomata existing in the epidermis on the under surface are 25 μ or more in length 42. *Pl. Chino* MAKINO

- 10 { A few hairs are found on the upper surface of leaves
 *Pl. nitakayamensis* (HAYATA) OHKI
 { Hairs are not found on the upper surface of leaves . . . *Pl. gramineus* NAKAI

C. Descriptions

34. *Pleioblastus linearis* NAKAI (Fig. 31), in Journ. Arnold Arb. VI. (1925) p. 146.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $30-81\mu$ long, $6-15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, on their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $6-9\mu$ long, $6-9\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 3μ in length, 15μ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two bands of them, there is found a band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting their band varies 2-4 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $13.3-24.9\mu$ long, $3.3-6.6\mu$ wide, and those of the lateral rows are about $13.3-24.9\mu$ long, $8.3-9.9\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21-40\mu$ in length, $9-18\mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are about elliptical, about 15μ in length, very few in number. No finger-like protuberance exists in stomata on the upper surface, which are found in those on the under surface. No ordinary hair. Genuiculate hairs are 2-celled, their walls being smooth, few in number. A few silica cells are rarely found in the epidermis above the veins. They are nearly rectangular in form, about $4.9-16.6\mu$ in length, $13.3-19.9\mu$ in breadth, disposed in about 1-5 rows nearly parallel to the veins. These cells in a row are arranged with the interval of about $6-21\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

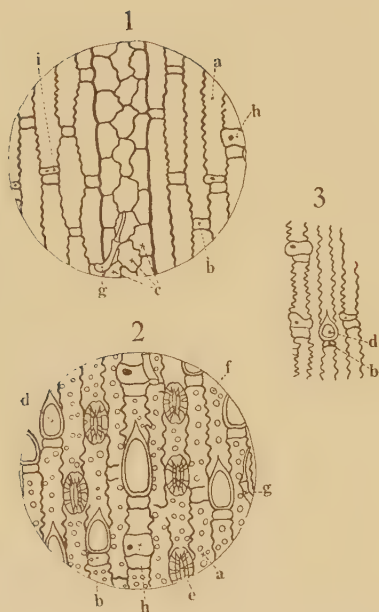


Fig. 31. *Pleioblastus linearis* NAKAI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24-54\mu$ in length, $12-21\mu$ in breadth, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6-29.9\mu$ in length, very numerous in number, disposed mostly in 1-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly scabrous, few in number. They exist on the epidermis above the assimilation tissue or rarely on the veins. Several silica cells containing especially large masses of silica are found in the epidermis above the veins.

They are nearly rectangular in form, about $4.5-18\mu$ in length, $12-18\mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. These silica cells in a row are arranged with the interval of about $1.6-149.4\mu$.

The following points are worthy of special attention:—

1. Geniculate hairs are found on the upper surface of leaves.
2. Hairs are found on the under surface of leaves, but they are not present on the upper surface.

3. The walls of the basal cells of geniculate hairs on the under surface are smooth or slightly scabrous.

NOM. JAP. Ryukyu-chiku.

HAB. Ryukyu.

35. *Pleioblastus communis* NAKAI, in Journ Arnold Arb. VI. (1925) p. 146.

a) *Epidermal cells constituting a greater part of the upper surface of leaves* are mostly longer rectangular cells. They are about $30\text{--}135\ \mu$ long, $12\text{--}15\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $6\text{--}9\ \mu$ long, $6\text{--}12\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3\ \mu$ in length, $12\ \mu$ in breadth, their walls being flat, few in number. These cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two bands of them, there exists the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or straight. The number of cell rows constituting this band varies 2–4 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $16.6\text{--}49.8\ \mu$ long, $9.9\text{--}13.3\ \mu$ wide, and those in the lateral rows are about $16.6\text{--}24.9\ \mu$ long, $6.6\text{--}14.9\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24\ \mu$ in length, $12\text{--}15\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $18\text{--}23.2\ \mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface. No hair. Geniculate hairs are 2-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\ \mu$ in length, $11.6\text{--}13.3\ \mu$ in breadth, disposed mostly in 1–3 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $15\text{--}90\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24-27\mu$ in length, $12-15\mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9-28.2\mu$ in length, very numerous in number, disposed mostly in 2-4 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. Ordinary hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6-9\mu$ in length, $9-12\mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $12-80\mu$.

The following points are worth mentioning for the investigation of the spodiogram of this species:—

1. Ordinary hairs are not found on the upper surface of leaves.
2. Comparatively numerous spine cells exist on the upper surface of leaves.
3. The walls of the geniculate hairs on the under surface are mostly smooth.

NOM. JAP. Goki-dake.

HAB. Honshū, Kyushū.

36. *Pleioblastus Usawai* (HAYATA) OHKI, in Bot. Mag. (Tokyo) XLII. (1928) p. 520.

Syn. *Arundinaria Usawai* HAYATA, Ic. Pl. Formos. VI. (1916) p. 138; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1424.

a) *Epidermal cells constituting a greater part of the epidermis on the upper surface* are mostly longer rectangular cells. They are about $18-90\mu$ long, $6-15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being

slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, and on their shorter sides, there exists a small and shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $6-9\mu$ long, $6-15\mu$ wide, their cell walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about 3μ in length, 15μ in breadth, their cell walls being flat, very few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two bands of them, there is found the band of articulation cells. The latter cells are polygonal in shape, their walls being wavy or flat. The number of cell rows constituting this band varies about 2-4 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $8.3-11.6\mu$ long, $6.6-8.3\mu$ wide, and those of the lateral rows are about $8.3-11.6\mu$ long, $14.9-16.6\mu$ wide. All of them are nearly similar in shape. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21-40\mu$ in length, $9-18\mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 15μ in length, very few in number. Hairs are 1-celled, few in number. Geniculate hairs are 2-celled, few in number. A few silica cells are rarely found in the epidermis above the veins. They are nearly rectangular in form, about $3.3-6.6\mu$ in length, $9.9-14.9\mu$ in breadth.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21-40\mu$ in length, $9-18\mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $14.9-21.6\mu$ in length, very numerous in number, disposed mostly in 3-4 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Ordinary hairs are 1-celled, few in number. Geniculate hairs are 2-celled, their walls being smooth, comparatively numerous in number. They exist mostly on the epidermis above the assimilation tissue. Protuberance on the epidermal cells are seen everywhere. They are found existing exclusively on the under

surface of leaves. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4-9\ \mu$ in length, $9-15\ \mu$ in breadth, disposed in several rows nearly parallel to the veins. Those which belong to the same row are arranged with the interval of about $24-40\ \mu$.

For the investigation of the spodogram of this species, it is necessary to pay attention to the following points:—

1. Geniculate hairs are found on the upper surface of leaves.
2. Ordinary hairs are found on both upper and under surfaces.
3. When the articulation band consists of 3 cell-rows, the cells in the middle and the lateral row are nearly similar in shape.

NOM. JAP. Kawakamuri-yadake.

HAB. Formosa.

37. Pleioblastus Kunishii (HAYATA) OHKI (Fig. 32), in Bot. Mag. (Tokyo) XLII. (1928) p. 521.

Syn. *Arundinaria Kunishii* HAYATA Ic. Pl. Formos. VI. (1916) p. 136.

a) *Epidermal cells constituting a greater part of the upper surface of leaves* are mostly longer rectangular cells. They are about $24-90\ \mu$ long, $6-24\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-12\ \mu$ long, $6-12\ \mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about $3-4.5\ \mu$ in length, $9-15\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several rows of cells nearly parallel to the midrib. Between any two bands, there is found the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows in this band is mostly 1-4 or more, varying according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells are about $9.9-28.2\ \mu$ long, $6.6-16.6\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $18-36\ \mu$ in length, $12-15\ \mu$ in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above

the surface. Stomata are scarcely found. Ordinary hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, few in number. Several silica cells containing an especially large mass of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}6.6\ \mu$ in length, $8.3\text{--}9.9\ \mu$ in breadth, disposed in 1 or more rows nearly parallel to a vein. Those which belong to the same row are arranged with the interval of about $30\text{--}90\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but they show some difference in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $27\text{--}60\ \mu$ in length, $12\text{--}21\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $18.3\text{--}24.9\ \mu$ in length, very numerous in number, disposed mostly in 3 or more rows nearly parallel to a vein. They exist in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. The stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, or slightly scabrous, few in number. They exist mostly on the epidermis above the assimilation tissue on both sides of a vein. Protuberances on the epidermal cells are met with everywhere. They are found existing

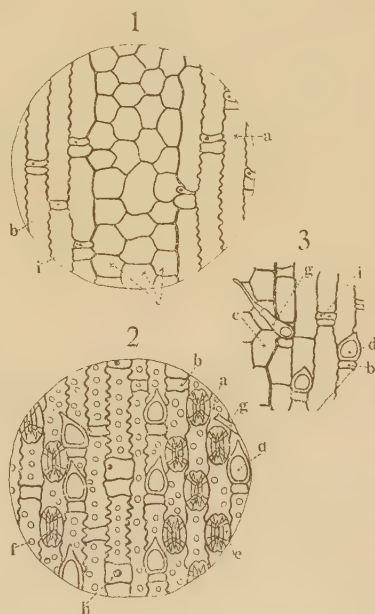


Fig. 32. *Pleioblastus Kunishii*
(HAYATA) OHKI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells and a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the assimilation tissue. \times ca. 194.

only on the under surface of a leaf. Several silica cells containing an especially large mass of silica are seen in the epidermis above the veins. They are nearly rectangular in form, about $9-15\mu$ in length, $12-21\mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. Those in the same row are arranged with the interval of about $6-96\mu$.

For the observation of the spodogram of this species, attention should be paid to the following points:—

1. Ordinary hairs and geniculate hairs are present on the upper surface of leaves.
2. Ordinary hairs are not found on the under surface of leaves.
3. A few spine cells are present on the upper surface of leaves.
4. The walls of the basal cells of geniculate hairs on the under surface are smooth or slightly scabrous.
5. Stomata in the epidermis on the under surface are mostly shorter than 25μ in length.
6. When the articulation band consists of 3 cell-rows, the cells in the middle and lateral row are nearly similar in shape.

NOM. JAP. Taiwan-yadake.

HAB. Formosa.

38. *Pleioblastus yamakitensis* MAKINO (Fig. 33), Fl. Jap. Bot. III. (1926) p. 11.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $21-150\mu$ long, $6-15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-6\mu$ long, $6-12\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 3μ in length, 9μ in breadth, their walls being flat, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two of these bands, there is found the band of articulation cells. These cells are polygonal or nearly rectangular in shape, their walls being wavy or flat. The number of cell rows forming a band varies about 2-6, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articula-

tion cells in the middle row are about $13.3\text{--}26.6\mu$ long, $9.9\text{--}14.9\mu$ wide, and those in the lateral rows are about $8.3\text{--}13.3\mu$ long, $13.3\text{--}16.6\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $18\text{--}90\mu$ in length, $9\text{--}27\mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly ovate or elliptical, about $19.9\text{--}24.9\mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface. Ordinary hairs are 1-celled, very few in number. Genuiculate hairs are 2-celled, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}9.9\mu$ in length, $13.3\text{--}19.9\mu$ in breadth, disposed mostly in 1–3 rows nearly parallel to a vein. Those which belong to the same row are separated with the interval of about $21\text{--}108\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surfaces, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24\text{--}36\mu$ in length, $15\text{--}18\mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6\text{--}29.9\mu$ in length, numerous in number, disposed mostly in 4–5 rows nearly parallel to a vein. They exist in the epidermis above

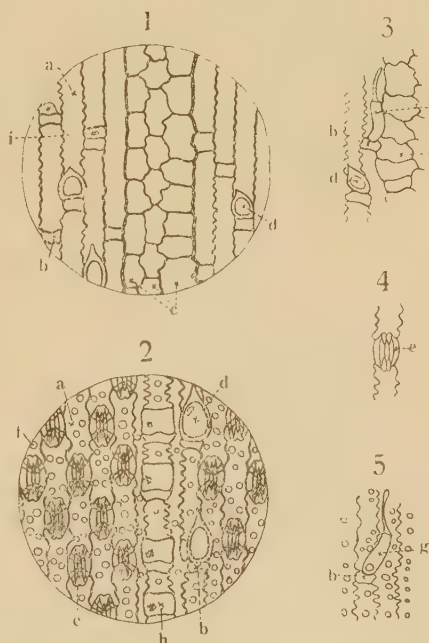


Fig. 33. *Pleioblastus yamakitensis* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell and a genuiculate hair. 4. Portion of the upper epidermis with a stoma. 5. Portion of the under epidermis with a genuiculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, genuiculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation cell. \times ca. 194.

the assimilation tissue on both sides of a vein. Those which belong to the same row are separated from one another as far as the length of a longer rectangular cell. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They are found only on the under surface of leaves. Several silica cells containing especially large masses of silica are seen in the epidermis above the veins. They are nearly rectangular in form, about $6-21\mu$ in length, $15-27\mu$ in breadth, disposed mostly in 1-8 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $6-36\mu$.

For the investigation of the spodogram of this species, attention should be paid to the following points:—

1. Ordinary hairs and geniculate hairs are found on the upper surface of leaves.
2. Ordinary hairs do not exist on the under surface of leaves.
3. The walls of the basal cells of geniculate hairs on the under surface are smooth.
4. Some stomata existing in the epidermis on the under surface are about 25μ or over in length.

NOM. JAP. Yamakita-dake.

HAB. Honshū.

39. *Pleiblastus variegata* MAKINO, Fl. Jap. Bot. III. (1926) p. 23.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $15-93\mu$ long, $6-15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-9\mu$ long, $6-15\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 6μ in length, 12μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two of these bands, there exists the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the

band varies mostly 2-5, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $16.6-33.2\mu$ long, $11.6-16.6\mu$ wide, and those in the lateral rows are about $11.6-16.6\mu$ long, $8.3-16.6\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 29.9μ in length, 9.9μ or more in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9-26.6\mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface. Ordinary hairs are 1-celled, few in number. No geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3-9.9\mu$ in length, $11.6-16.6\mu$ in breadth, disposed mostly in 1-4 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $3-40\mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 24μ in length, 9μ in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-26.6\mu$ in length, numerous in number, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells and incline towards the center of stomata. Ordinary hairs are 1-celled, comparatively numerous in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of leaves. Silica cells containing especially large masses of silica are seen in the epidermis above the veins. They are nearly rectangular in form, about $6-9\mu$ in length, $9-15\mu$ in breadth, disposed mostly in 1 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $9-45\mu$.

The following points are worthy of mention in the study of the spodogram of this species:—

1. Geniculate hairs are not found on the upper surface of leaves.
2. Spine cells and ordinary hairs exist on the upper surface of leaves.

NOM. JAP. Chigozasa.

HAB. Japan, cultivated.

40. *Pleiblastus oiwakensis* (HAYATA) OHKI (Fig. 34), in Bot. Mag. (Tokyo) XLII. (1928) p. 200.

Syn. *Arundinaria oiwakensis* HAYATA, Ic. Pl. Formos. VI. (1916) p. 137; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1424.

a) *Epidermal cells constituting a greater part of the upper surface of leaves* are mostly longer rectangular cells. They are about $24-96\mu$ long, $6-12\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly wavy or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells just mentioned, and adjoining to their shorter sides, there is found a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-6\mu$ in length, $4-9\mu$ in breadth, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 6μ in length, 7.5μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several rows of cells nearly parallel to the midrib. Between any two of these bands, there is found a band of articulation cells. These cells are polygonal or nearly rectangular in shape, their walls being wavy or flat. The number of cell rows in this band is mostly 1-3 or more, according to the distance from the midrib. When the articulation bands consist of 3 cell-rows, the articulation cells in the middle row are about $16.6-24.9\mu$ long, $9.9-11.6\mu$ wide, and those in the lateral rows are about $8.3-18.3\mu$ long, $8.3-13.3\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15-27\mu$ in length, $7-12\mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are scarcely found. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3-4.9\mu$ in length, $8.3-9.9\mu$ in breadth, disposed in mostly 1-3 rows nearly parallel to a vein. Those which belong to the same row are arranged with the interval of about $54-150\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21-36\ \mu$ in length, $12-15\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-24.9\ \mu$ in length, very numerous in number, disposed in about 2-3 rows nearly parallel to a vein. They exist in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center so as to close the stomata. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells exist everywhere. They are seen only on the under surface of leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6-9\ \mu$ in length, $9-12\ \mu$ in breadth, disposed mostly in 1-3 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $12-90\ \mu$.

The following points are mentioned as worthy of attention:—

1. Ordinary and geniculate hairs are not found on the upper surface of the leaves.
2. Spine cells exist on the upper surface of the leaves.
3. Ordinary hairs are not found on the under surface of the leaves.

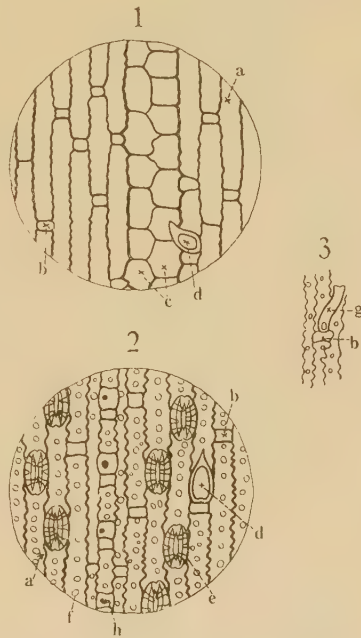


Fig. 34. *Pleioblastus oirakensis*
(HAYATA) OHKI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of a leaf, seen from without. 3. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell as found in the epidermis on a vein. \times ca. 194.

NOM. JAP. Taiwan-medake.

HAB. Formosa.

41. *Pleioblastus Simoni* NAKAI (Fig. 35), in Journ. Arnold Arb. VI. (1925) p. 147.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $21\text{--}66\ \mu$ long, $9\text{--}21\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, abjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells about are $3\text{--}6\ \mu$ long, $4\text{--}6\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $6\ \mu$ in length, $8\ \mu$ in breadth, their walls being flat, few in number. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several rows of cells nearly parallel to the midrib. Between any two bands, there is found a band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows in this band is mostly 1-3 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows the articulation cells in the middle row are about $8.3\text{--}26.6\ \mu$ long, $8.3\text{--}13.3\ \mu$ wide, and those in the lateral rows are about $8.3\text{--}16.6\ \mu$ long, $6.6\text{--}14.9\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15\text{--}18\ \mu$ in length, $9\text{--}12\ \mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9\text{--}24\ \mu$ in length, few in number. No finger-like protuberance exists in stomata on the upper surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9\text{--}8.3\ \mu$ in length, $9.9\text{--}13.3\ \mu$ in breadth, disposed mostly in 2-3 or more rows nearly parallel to a vein. Those which belong to the same row are arranged with the interval of about $30\text{--}50\ \mu$ or more.

6) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $24\text{--}30\ \mu$ in length, $12\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly

rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $18.3\text{--}24.9\mu$ in length, very numerous in number, disposed in about 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata in a row are separated from one another as far as the length of a longer rectangular cell. Ordinary hairs are 1-celled, very few in number. Genuiculate hairs are 2-celled, the walls of their basal cells being smooth or rarely slightly scabrous, few in number. Several silica cells containing especially large masses of silica are found in the epidermis above a vein. They are nearly rectangular in form, about $6\text{--}12\mu$ in length, $12\text{--}15\mu$ in breadth, disposed in about 2-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $36\text{--}150\mu$.

For the investigation of spodogram of this species, attention should be paid to the following points:—

1. Spine cells are found on the upper surface of leaves.
2. Ordinary and genuiculate hairs are absent on the upper surface of leaves.
3. A few hairs exist on the under surface of leaves.
4. The walls of the basal cells of genuiculate hairs on the under surface are smooth or slightly scabrous.

NOM. JAP. Medake.

HAB. Honshū, Shikoku, Kyushū.

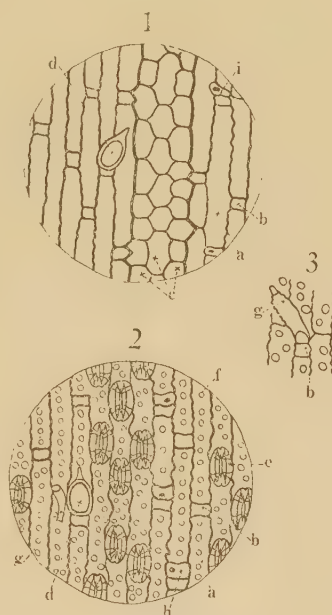


Fig. 35. *Pleioblastus Simoni* NAKAI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under surface taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with a genuiculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, genuiculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

42. *Pleiblastus Chino* MAKINO (Fig. 36), Fl. Jap. Bot. III. (1926) p. 23.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $36\text{--}75\mu$ long, $9\text{--}15\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3\text{--}6\mu$ long, $6\text{--}12\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in

form, about 3μ in length, 15μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several rows of cells nearly parallel to the midrib. Between any two of the bands, there is the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or even. The number of cell rows in this band is mostly 2–5 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $6.6\text{--}29.9\mu$ long, $6.6\text{--}16.6\mu$ wide, and those in the lateral rows are about $8.3\text{--}24.9\mu$ long, $9.9\text{--}16.6\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $12\text{--}150\mu$ in length, $12\text{--}45\mu$ in diameter, very numerous in

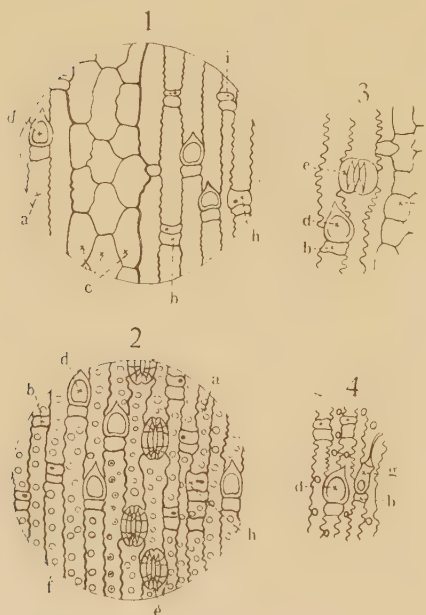


Fig. 36. *Pleiblastus Chino* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell and a stoma. 4. Portion of the under epidermis with a spine cell and a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9-8.3\mu$ in length, $13.3-16.6\mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $8.3-149.4\mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $21-24\mu$ in length, $12-15\mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $21.6-28.2\mu$ in length, very numerous in number, disposed in about 3-rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. These stomata belonging to the same row are separated from each other so far as the length of a longer rectangular cell. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth or slightly serrate, few in number. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3-15\mu$ in length, $6-15\mu$ in breadth, disposed in mostly 2-3 or more rows nearly parallel to a vein. Those in a row are arranged with the interval of about $4.9-116.2\mu$ or more.

In making the investigation of the spodogram of this species, the following points are worthy of special attention:—

1. Geniculate and ordinary hairs are absent on the upper surface of leaves.
2. Ordinary hairs are not found on the under surface of leaves.
3. The walls of the geniculate hairs are smooth or slightly scabrous.

NOM. JAP. *Adzuma-nezasa*.

HAB. Honshū, Shikoku, Kyushū.

43. *Pleioblastus niitakayamensis* (HAYATA) OHKI, in Bot. Mag. (Tokyo) XLII. (1928). p. 202.

Syn. *Arundinaria niitakayamensis* HAYATA, in Bot. Mag. (Tokyo) XXI. (1907) pp. 49-50; HAYATA, Fl. Mount. Formos. (1908) p. 240

et Ic. Pl. Formos. VI. (1916) p. 137 et VII. (1917) p. 94; NEMOTO and MAKINO, Fl. Jap. (1925) p. 1423.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $15-60\mu$ in length, $6-15\mu$ in breadth, their two longer sides being slightly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-9\mu$ long, $6-9\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3-4.9\mu$ in length, $9.9-11.6\mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two of these bands, there exists a band of articulation cells. These cells are polygonal or nearly rectangular in shape, their walls being wavy or straight. The number of cell rows making up the band varies 1-5 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the middle row are about $8.3-19.9\mu$ long, $6.6-11.6\mu$ wide, and those in the lateral rows are about $8.3-16.6\mu$ long, $4.9-9.9\mu$ wide. No spine cell. Stomata are scarcely found. No geniculate hair. Ordinary hairs are 1-celled, very few in number. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $4.9-6.6\mu$ in length, $8.3-9.9\mu$ in breadth, disposed in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $9-150\mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15-30\mu$ in length, $9-18\mu$ in diameter, numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-24.9\mu$ in length, very numerous in number, disposed mostly in 2 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far

as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center so as to close the stomata. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are seen chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6-12\mu$ in length, $9-12\mu$ in breadth, disposed mostly in 1-4 rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $4-129\mu$.

For the study of the spodogram of this species, attention should be paid to the following points:—

1. Spine cells and geniculate hairs are not found on the upper surface of the leaves.
2. A few ordinary hairs are found on the upper surface of the leaves.

NOM. JAP. Niitaka-yadake, Niitaka-medake.

HAB. Formosa.

44. *Pleioblastus gramineus* NAKAI (Fig. 37), in Journ. Arnold Arb. VI. (1925) p. 146.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $27-105\mu$ long, $4-18\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $4-6\mu$ long, $4-12\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about 3μ in length, 9μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the midrib. Between any two of the bands, there is found the band of articulation cells. These cells are polygonal or nearly rectangular in shape, their walls being undulate or even. The number of cell rows constituting this band varies 2-4, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the articulation cells in the

middle row are about $6.6\text{--}24.9\ \mu$ long, $9.9\text{--}11.6\ \mu$ wide, and those in the lateral rows are about $9.9\text{--}19.9\ \mu$ long, $6.6\text{--}16.6\ \mu$ wide. No spine cell. Stomata are nearly elliptical, about $24.9\text{--}26.6\ \mu$ in length, very few in number. No finger-like protuberance around stomata is found on the upper surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.3\text{--}4.9\ \mu$ in length, $8.3\text{--}9.9\ \mu$ in breadth, disposed in mostly 4–5 or more rows, nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $24\text{--}110\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but they show some difference in the following points:—

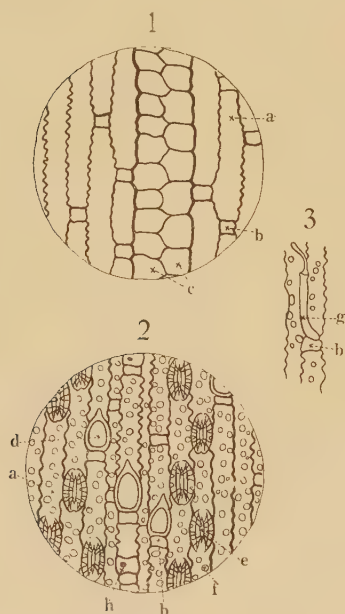


Fig. 37. *Pleioblastus gramineus* NAKAI

1. Upper epidermis taken from the nearly middle portion on one side of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of a leaf, seen from without. 3. Portion of the under epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein \times ca. 194.

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $27\text{--}51\ \mu$ in length, $15\text{--}18\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $24.9\text{--}28.2\ \mu$ in length, very numerous in number, disposed mostly in 2–3 rows, nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Geniculate hairs are 2-celled, the walls of their basal cells being smooth or slightly scabrous, few in number. They are found chiefly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells

are found everywhere. They exist only on the under surface of leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6-15\mu$ in length, $15-21\mu$ in breadth, disposed in 1-5 or more rows nearly parallel to a vein. Those which belong to the same row are arranged with the interval of about $3-90\mu$.

The following points are worthy of attention for the investigation of the spodogram of this species:—

1. Spine cells and geniculate hairs are not found on the upper surface of leaves.
2. Ordinary hairs are not found on the upper surface of leaves.

NOM. JAP. Taimin-chiku.

HAB. Japan, cultivated.

11. *Phyllostachys* SIEBOLD et ZUCCARINI

SIEBOLD et ZUCCARINI, in Abh. Akad. der Wiss. Münch. III.

(1843) p. 745; MUNRO, Monograph Bambus. (1866) p.

35; E. G. CAMUS, Bambus. (1913) p. 56; NEMOTO

and MAKINO, Fl. Jap. (1925) p. 1405.

As to the spodogram of the epidermis of the leaves, I have usually observed it from above (i. e. from the outer side). The following descriptions of spodogram are taken from the preparations made from the middle portion of a leaf (i. e. nearly an inch square on both sides of the midrib). I have omitted those from both the basal and the apical portions.

A. General remarks

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $12-100\mu$ long, $3.4-17\mu$ wide, their two longer sides being remarkably wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-9\mu$ long, $5-12\mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.4-7\mu$ in length, $3.4-13.6\mu$ in breadth, their walls being flat. Epidermal cells of these three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly

parallel to the veins. Between any two of these bands, there is found the band of articulation cells. The articulation cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting this band varies 1-6 or more, according to the distance from the midrib. When the band of articulation cells consists of 3 cell rows, the longer sides of these cells which exist in its middle portion are mostly longer than those longer sides of the other portion. These articulation cells in the middle row are about $11.6-46.5\ \mu$ long, $3.3-16.6\ \mu$ wide, and those in the lateral rows are about $6.6-24.9\ \mu$ long, $6.6-21.6\ \mu$ wide. Some species have spine cells, while the others have not. They are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $9.9-30\ \mu$ in length, $9-15\ \mu$ in diameter, few or numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-24.9\ \mu$ in length, few in number. No finger-like protuberance exists around stomata on the upper surface. Geniculate hairs are found or not found. These geniculate hairs are 2-celled, their walls being smooth, few in number. Several silica cells containing especially large masses of silica exist in the epidermis above the veins. They are nearly rectangular in form, about $6.4-16.6\ \mu$ in length, $9.9-24.9\ \mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.7-180\ \mu$ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface in general, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16.9-60\ \mu$ in length, $8.6-26\ \mu$ in diameter, generally numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $14.9-26.5\ \mu$ in length, very numerous in number, disposed mostly in 2-3 or more rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells which adjoin to the guard cells, and incline towards the center so as to close the stomata. Ordinary hairs are found or not found. When present, they are 1-celled, few in number. Geniculate hairs are 2-celled, their walls being smooth, few or comparatively numerous in number. Protuberances

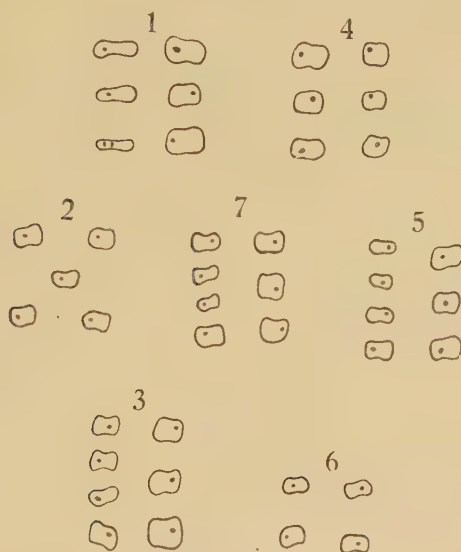


Fig. 38. Different kinds of silica cells in the upper epidermis above the veins in the different species of the genus. They are taken from the upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 1. *Phyllostachys bambusoides* SIEBOLD et ZUCCARINI; 2. *Ph. Makinoi* HAYATA; 3. *Ph. nigra* MUNRO var. *Henonis* MAKINO; 4. *Ph. mitis* A. et C. RIVIÈRE; 5. *Ph. nigra* MUNRO; 6. *Ph. nigripes* HAYATA; 7. *Ph. formosana* HAYATA \times ca. 194.

on the epidermal cells are found everywhere. They are found existing only on the under surface of the leaves. Several silica cells containing especially large masses of silica exist in the epidermis above the veins. They are nearly rectangular in form, about $6.8\text{--}17\ \mu$ in length, $6.8\text{--}25\ \mu$ in breadth, disposed mostly in 1-3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.6\text{--}180\ \mu$ or more.

B. Key to the species

- 1 { Geniculate hairs exist on the upper surface of the leaves 2
- 1 { Geniculate hairs are not found on the upper surface of the leaves 3
- 2 { Ordinary hairs are present on the under surface of the leaves 45. *Phyllostachys bambusoides* SIEBOLD et ZUCCARINI
- 2 { Ordinary hairs are absent on the under surface of the leaves 46. *Ph. Makinoi* HAYATA
- 3 { Spine cells exist on the upper surface of the leaves 4
- 3 { Spine cells are not found on the upper surface of the leaves 5

- 4

{

Some stomata existing in the epidermis on the under surface are 25μ or more in length. Ordinary hairs are rarely found on the under surface
 47. *Ph. nigra* MUNRO var. *Henonis* MAKINO
Stomata existing in the epidermis on the under surface are shorter than 25μ in length. Ordinary hairs are not found on the under surface
 48. *Ph. mitis* A. et C. RIVIÈRE

}
- 5

{

The number of cell rows constituting the band of articulation cells in the epidermis on the upper surface varies mostly 1-3 or more, according to the distance from the midrib . 49. *Ph. nigra* MUNRO 50. *Ph. nigripes* HAYATA
The number of cell rows consisting the band of articulation cells in the epidermis on the upper surface varies 1-3, according to the distance from the midrib 51. *Ph. formosana* HAYATA

}

C. Descriptions

45. *Phyllostachys bambusoides* SIEBOLD et ZUCCARINI (Fig. 39), in Abh. Akad. der Wiss. Münch. III. (1843) p. 745.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $26.5-100\mu$ long, $10.9-16.6\mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $3-9\mu$ long, $5-8\mu$ wide, their walls being slightly undulate or flat. The silica cells are nearly rectangular in form, about 3.4μ in length, $3.4-9.5\mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there exists the band of articulation cells. They are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies about 2-8, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the longer sides of the articulation cells in the middle row are mostly longer than those of the lateral ones, that is, the articulation cells in the middle row are about $11.6-28.2\mu$ long, $4.9-16.6\mu$ wide, and those in the lateral rows are about $6.6-21.6\mu$ long, $6.6-19.9\mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $9-27.6\mu$ in length, $9-18\mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the

surface. They are found mostly next to the shorter rectangular cell. Stomata are nearly ovate, about $16.6\text{--}19.9\ \mu$ in length, few in number. No finger-like protuberance around the stomata exists on the upper surface. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, very few in number, found only in the portion near the margin. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}16.6\ \mu$ in length, $14.9\text{--}24.9\ \mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $3\text{--}80\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or

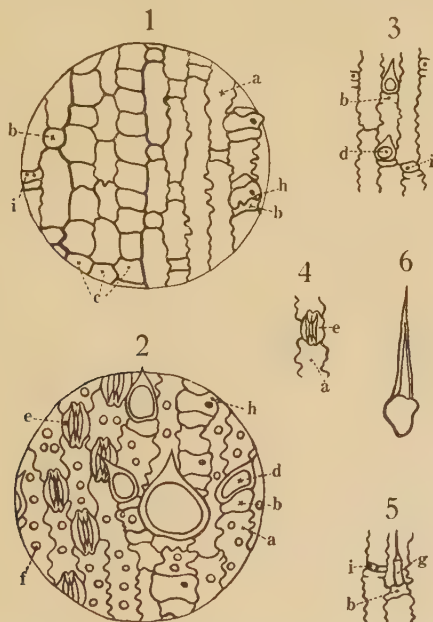


Fig. 39. *Phyllostachys bambusoides* SIEBOLD et ZUCCARINI

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with two spine cells. 4. Portion of the upper epidermis with a stoma. 5. Portion of the upper epidermis with a geniculate hair. 6. Ordinary hair on the under epidermis. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

acute at the apex, about $24.9\text{--}58.1\ \mu$ in length, $8.3\text{--}23.3\ \mu$ in diameter, numerous in number. These spine cells on the epidermis above the veins are mostly larger than those on the epidermis above the assimilation tissue. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6\text{--}21.6\ \mu$ in length, very numerous in number, disposed mostly in 2–3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. These stomata belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances are found or not found in stomata. These protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of the stomata. Ordinary hairs are 1-celled, few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. They exist on the epidermis above the assimilation tissue or rarely above the veins. Protuberances on the epidermal cells are found everywhere. They are seen only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.6\text{--}13.3\ \mu$ in length, $13\text{--}25\ \mu$ in breadth, disposed in mostly 1–3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $1.6\text{--}150\ \mu$ or more.

For the investigation of the spodogram of this species, the following few points may be mentioned as worthy of special attention:—

1. Spine cells and geniculate hairs are found on the upper surface of the leaves.
2. A few hairs are seen only on the under surface of the leaves.

NOM. JAP. Ma-dake.

HAB. Japan, cultivated.

46. *Phyllostachys Makinoi* HAYATA (Fig. 40), Ic. Pl. Formos. V. (1915) p. 250.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $17\text{--}85\ \mu$ long, $8.5\text{--}17\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the former and the latter. The shorter rectangular cells are about $3.4\text{--}8.5\ \mu$ long,

5–12 μ wide, their walls being wavy or flat. The silice cells are nearly rectangular in form, about 5–7 μ in length, 11–13.6 μ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there exists the band of articulation cells. The articulation cells are rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting this band varies mostly 2–5 or more, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the longer sides of the articulation cells existing in the middle of the band are mostly longer than those of the lateral cells. The former cells are about 16.6–33.2 μ long, 3.3–8.3 μ wide, the latter cells are about 16.6–21.6 μ long, 8.3–13.3 μ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 17–34 μ in length, 13–17 μ in diameter, found easily on the portion near the margin or very rarely on other portions. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 16.6–24.9 μ in length, few in number. No finger-like protuberance exists around stomata on the upper surface. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found chiefly near the margin. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about 9.9–13.3 μ in length, 13.3–16.6 μ in breadth, disposed mostly in a single row nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about 1.7–170 μ or more.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about 25–51 μ in length, 13.5–26 μ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about 16.6–24.9 μ in length, very numerous in number, disposed mostly in 2–3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Geniculate hairs are

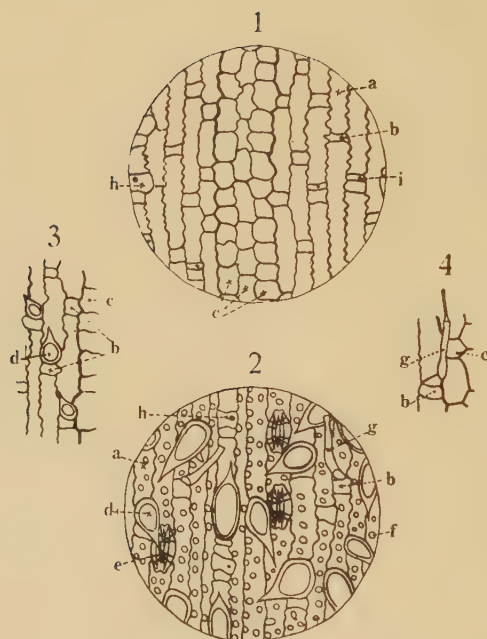


Fig. 40. *Phyllostachys Makinoi* HAYATA

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with spine cells. 4. Portion of the upper epidermis with a geniculate hair. a, longer rectangular cell; b, shorter rectangular cells; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

2-celled, their walls being smooth, comparatively numerous in number. Protuberances on the epidermal cells are found everywhere. They are limited to the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.5\text{--}12\ \mu$ in length, $12\text{--}15\ \mu$ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $1.7\text{--}97\ \mu$.

For the study of the spodogram of this species, it is necessary to pay attention to the following points:—

1. Geniculate hairs are found on both surfaces of the leaves and their walls are smooth.

2. Ordinary hairs are absent on the under surface of the leaves.

NOM. JAP. Kei-chiku.

HAB. Formosa.

47. *Phyllostachys nigra* MUNRO var. *Henonis* MAKINO (Fig. 14), in Bot. Mag. (Tokyo) XXVI. (1912) p. 25; MUNRO, Monograph Bambus. (1866) p. 38.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $12-68\ \mu$ long, $3.4-16.5\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the longer and the shorter. The shorter rectangular cells are about $5-8.5\ \mu$ long, $5-10.2\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3-4.9\ \mu$ in length, $11.6-20\ \mu$ in breadth, their walls being flat. They are usually found near the margin, but rarely on the other portions. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is the band of articulation cells. The articulation cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies mostly 2-6, according to the distance from the midrib. When the articulation band consists of more than 3 cell rows, the longer sides of the articulation cells in the middle of the band are mostly longer than those of the lateral ones. The articulation cells in the middle row are about $13.3-46.5\ \mu$ long, $4.9-16.6\ \mu$ wide, and those in the lateral rows are about $11.6-23.2\ \mu$ long, $11.6-13.3\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $15\ \mu$ in length, $9\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are scarcely found. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.4-16.6\ \mu$ in length, $11.6-19.9\ \mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $6.8-108\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly

resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $18-36\ \mu$ in length, $9-15\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. They are found on the epidermis above the assimilation tissue or veins. Stomata are nearly elliptical, about $14.9-26.5\ \mu$ in length, very numerous in number, disposed mostly in 2-3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those in the

same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of the stomata. Ordinary hairs are 1-celled, very few in number. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $6.8-11\ \mu$ in length, $11.9-17\ \mu$ in breadth, disposed in 1-2 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $3-180\ \mu$ or more.

The following points are mentioned as worthy of special attention:—

1. Geniculate hairs are not found on the upper surface of the leaves.

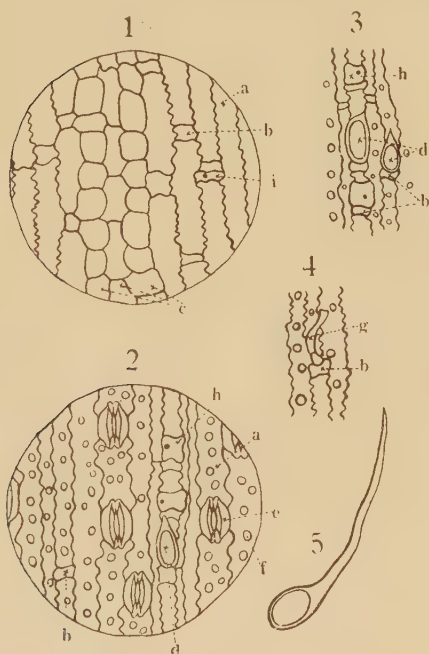


Fig. 41. *Phyllostachys nigra* MUNRO
var. *Henonis* MAKINO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with spine cells. 4. Portion of the under epidermis with a geniculate hair. 5. Ordinary hair on the under epidermis. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cell in the epidermis on a vein; i, silica cell in the epidermis on the assimilation tissue. \times ca. 194.

2. A few spine cells exist on the upper surface of the leaves.
 3. Some stomata in the epidermis on the under surface are about $25\ \mu$ or more in length.
 4. A few ordinary hairs are found on the under surface of the leaves.
- NOM. JAP. Ha-chiku.
HAB. Japan, cultivated.

48. **Phyllostachy mitis** A. et C. Rivière (Fig. 42), Bambous. (1879) p. 231 ; E. G. CAMUS, Bambus. (1913) pp. 63-64.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $22-60\ \mu$ long, $8-14\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells and in contact with their shorter sides, there exists a small shorter rectangular cell, with or without a silica cell between the former and the latter. The shorter rectangular cells are about $3.4-8.5\ \mu$ long, $5-8.5\ \mu$ wide, their walls being slightly wavy or flat. The silica cells are nearly rectangular in form, about $3.3-4.9\ \mu$ in length, $11.6-16.7\ \mu$ in breadth, their walls being flat. These cells of three kinds, one longer, two shorter (one with silica and the other without silica), make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is located the band of articulation cells. The latter cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies mostly 1-6, according to the distance from the midrib. When the articulation band consists of 3 cell rows, the longer sides of the articulation cells existing in the middle are mostly longer than those of the lateral ones. Those in the middle row are about $13.3-28.2\ \mu$ long, $4.2-8.3\ \mu$ wide, and those in the lateral rows are about $8.3-19.9\ \mu$ long, $8.3-19.9\ \mu$ wide. Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $17\ \mu$ in length, $12\ \mu$ in diameter, very few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6-18.7\ \mu$ in length, very few in number. No finger-like protuberance exists around the stomata on the upper surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $9.9-13.3\ \mu$ in length, $9.9-16.6\ \mu$ in breadth, disposed mostly in 1-2 rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $34-155\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $16\text{--}29\ \mu$ in length, $6.8\text{--}12\ \mu$ in diameter, comparatively numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6\text{--}21.6\ \mu$ in length, very numerous in number,

disposed mostly in 2–3 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those belonging to the same row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances are found around the stomata. They come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. Protuberances are found everywhere. They exist only on the under surface of a leaf. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8\text{--}17\ \mu$ in length, $6.8\text{--}12\ \mu$ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $6.8\text{--}46\ \mu$.

The following points are worth mentioning:—

1. Geniculate hairs are not found on the upper surface of the leaves.

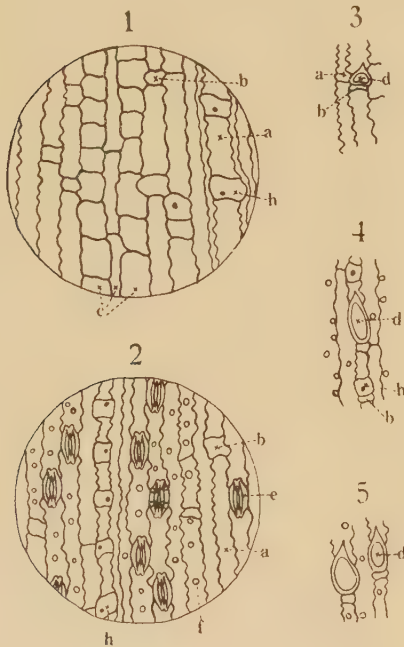


Fig. 42. *Phyllostachys mitis* A. et C.
RIVIÈRE

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the upper epidermis with a spine cell. 4. Portion of the under epidermis on the vein with a spine cell. 5. Portion of the under epidermis on the assimilation tissue with spine cells. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; h, silica cell in the epidermis on a vein.

× ca. 194.

2. A few spine cells exist only near the margin on the upper surface of the leaves.
3. Stomata existing in the epidermis on the under surface are shorter than $25\ \mu$ in length.
4. Hairs are not found on the under surface of the leaves.

NOM. JAP. Mōsō-chiku.

HAB. Japan, cultivated.

49. *Phyllostachys nigra* MUNRO (Fig 43), Monograph Bambus. (1866) p. 38.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $15\text{--}60\ \mu$ long, $3.4\text{--}10.5\ \mu$ wide, their two longer sides being strongly wavy, nearly parallel to the midrib, and the other two shorter sides being slightly undulate or straight, nearly perpendicular to the longer sides. Between any two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell, between the former and the latter. The shorter rectangular cells are about $5\text{--}6.8\ \mu$ long, $5\text{--}8.5\ \mu$ wide, their walls being slightly wavy or flat. Silica cells are scarcely found in the epidermis above the assimilation tissue. These cells of two kinds, longer and shorter, make a number of bands which consist of several cell rows nearly parallel to the veins. Between any two of these bands, there is located the band of articulation cells. These cells are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies mostly 1–3 or rarely more, according to the distance from the midrib. When the band of articulation cells consists of 3 cell rows, the longer sides of cells in the central row are mostly longer than those of the lateral rows. Those in the middle row are about $16.6\text{--}24.9\ \mu$ long, $4.9\text{--}6.6\ \mu$ wide, and those in the lateral rows are about $11.6\text{--}24.9\ \mu$ long, $9.9\text{--}11.6\ \mu$ wide. No spine cell. Stomata are nearly ovate, about $16.6\ \mu$ in length, very few in number. No finger-like protuberance exists around the stomata on the upper surface. Neither ordinary nor geniculate hair. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $3.4\text{--}11\ \mu$ in length, $11\text{--}15.5\ \mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. These silica cells belonging to the same row are arranged with the interval of about $11\text{--}110\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or

acute at the apex, about $13-40\ \mu$ in length, $8.5-17\ \mu$ in diameter, few in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $19.9-25\ \mu$ in length, very numerous in number, disposed mostly in 1-3 rows nearly parallel to a vein. They exist in the epidermis above the assimilation tissue on both sides of a vein. Those in a row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances come forth from the epidermal cells adjoining to the guard cells, and incline towards the center of stomata. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, few in number. They are found mostly on the epidermis above the assimilation tissue. Protuberances on the epidermal cells are

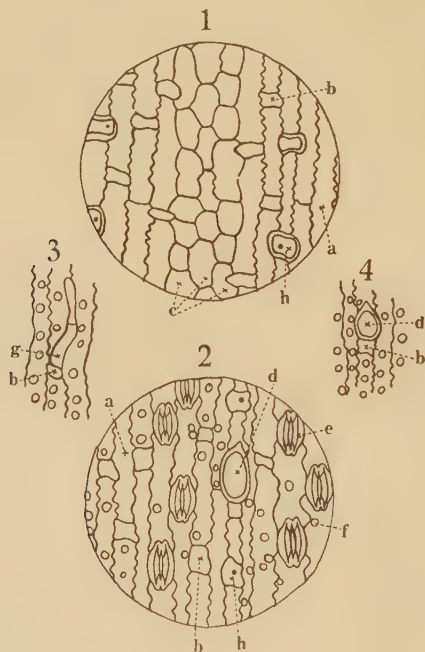


Fig. 43. *Phyllostachys nigra* MUNRO

1. Upper epidermis taken from the nearly middle portion on one side of the midrib between two extremities (apex and base) of a leaf, seen from without. 2. Under epidermis taken from the nearly middle portion on one side of the midrib, seen from without. 3. Portion of the under epidermis with a geniculate hair. 4. Portion of the under epidermis with a spine cell. a, longer rectangular cell; b, shorter rectangular cell; c, articulation cells; d, spine cell; e, stoma; f, papilla-like protuberance; g, geniculate hair; h, silica cells in the epidermis on a vein. \times ca. 194.

found everywhere. They exist only on the under surface of the leaves. Silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.5\text{--}11.5\ \mu$ in length, $8.5\text{--}11.5\ \mu$ in breadth, disposed in 1 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $17\text{--}170\ \mu$ or more.

As to the spodogram of this species, attention should be paid to the following points:—

1. Spine cells and geniculate hairs are not found on the upper surface of the leaves.
2. The number of cell rows constituting the band of articulation cells in the epidermis on the upper surface varies mostly 1–3 or more, according to the distance from the midrib.

NOM. JAP. Kuro-chiku.

HAB. Japan, cultivated.

50. *Phyllostachys nigripes* HAYATA, Ic. Pl. Formos. VI. (1916) p. 142.

The spodogram of the leaves of this species nearly resembles that of *Phyllostachys nigra* MUNRO.

NOM. JAP. Taiwan-kurochiku.

HAB. Formosa.

51. *Phyllostachys formosana* HAYATA, Ic. Pl. Formos. VI. (1916) p. 140.

a) *Epidermal cells constituting the upper surface of leaves* are mostly longer rectangular cells. They are about $16.7\text{--}66.4\ \mu$ long, $8.3\text{--}16.6\ \mu$ wide, their walls being strongly wavy, nearly parallel to the midrib, and the other two shorter sides slightly undulate or straight, nearly perpendicular to the longer sides. Between two longer rectangular cells, adjoining to their shorter sides, there exists a small shorter rectangular cell. They are about $3.3\text{--}8.3\ \mu$ long, $6.6\text{--}8.3\ \mu$ wide, their walls being wavy or flat. Silica cells adjoining to the shorter rectangular cells are scarcely found in the epidermis above the assimilation tissue. These cells of two kinds, longer and shorter, make a number of bands which consist of several cell rows nearly parallel to the veins. Between two of these bands, there exists the band of articulation cells. These are nearly rectangular or polygonal in shape, their walls being wavy or flat. The number of cell rows constituting the band varies about 1–3, according to the distance from the midrib. When the articulation band consists of 3 cell-rows, the longer sides of the articulation cells in the

middle of the band are longer than those of the lateral ones. Those in the middle row are about $14.9\text{--}33.2\ \mu$ long, $4.9\text{--}13.3\ \mu$ wide, and those in the lateral rows about $11.6\text{--}13.3\ \mu$ long, $13.3\ \mu$ wide. No spine cell. Neither ordinary nor geniculate hair. Stomata are nearly elliptical, about $16.6\text{--}19.9\ \mu$ in length, very few in number. No finger-like protuberance exists around the stomata on the upper surface. Several silica cells containing especially large masses of silica are found in the epidermis above the veins. They are nearly rectangular in form, about $8.3\text{--}13.3\ \mu$ in length, $11.6\text{--}18.3\ \mu$ in breadth, disposed mostly in a single row nearly parallel to a vein. These silica cells belonging to a row are separated with the interval of about $8.5\text{--}45\ \mu$.

b) *Epidermal cells constituting the under surface of leaves* nearly resemble those of the upper surface, but differ in the following points:—

Spine cells are nearly elliptical, rounded at the base, cuspidate or acute at the apex, about $25.5\text{--}60\ \mu$ in length, $8.5\text{--}25.5\ \mu$ in diameter, very numerous in number. Viewed from the side, they are nearly rostrate in shape, projecting a little above the surface. Stomata are nearly elliptical, about $16.6\text{--}24.9\ \mu$ in length, very numerous in number, disposed mostly in 2 rows nearly parallel to a vein. They are found in the epidermis above the assimilation tissue on both sides of a vein. Those in a row are separated from one another as far as the length of a longer rectangular cell. Finger-like protuberances are not found around stomata. No ordinary hair. Geniculate hairs are 2-celled, their walls being smooth, comparatively numerous in number. Protuberances on the epidermal cells are found everywhere. They exist only on the under surface of the leaf. Several silica cells containing especially large masses of silica are seen in the epidermis above the veins. They are nearly rectangular in form, about $8.5\text{--}13.6\ \mu$ in length, $13.6\text{--}17\ \mu$ in breadth, disposed in 1–3 or more rows nearly parallel to a vein. Those belonging to the same row are arranged with the interval of about $1.7\text{--}94\ \mu$.

In the spodiogram of this species, the following points are of some importance:—

1. Spine cells, ordinary and geniculate hairs are not found on the upper surface of the leaves.
2. The number of cell rows constituting the band of articulation cells in the epidermis on the upper surface are mostly 1–3, varying according to the distance from the midrib.

NOM. JAP. Jinmen-chiku.

HAB. Formosa.

V. Conclusion and Additions

The following tables show the difference of spodograms in the leaves of different species belonging to *Bambusa* SCHREBER, *Sasa* MAKINO et SHIBATA, *Pseudosasa* MAKINO, *Sasaella* MAKINO, *Pleioblastus* NAKAI and *Phyllostachys* SIEBOLD et ZUCCARINI.

TABLE I.

Showing the various characters of the spodograms
in the leaves of *Bambusa* SCHREBER.

Species	Criteria				The number of cell rows constituting the bands of articulation cells	The length of stomata in the epidermis on the under surface	The walls of the geniculate hairs on the under surface
	Hairs on the upper surface of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves	Hairs on the under surface of leaves			
<i>Bambusa Oldhami</i>			×	×	2-3 or more	21-24 μ	smooth
<i>B. stenostachya</i>			×	×	2-3 "	16.6-20 μ	"
<i>B. dolichomerithalla</i>		×	×	×	3 "	21.5-26.6 μ	"
<i>B. Shimadai</i>		×		×	2-3	19.9-24.9 μ	"
<i>B. nana</i>		×	×	×	2-3 or more	23.2-26.6 μ	"
<i>B. dolichoclada</i>		×	×	×	2-4	15 μ	"
<i>B. breviflora</i>		×	×	×	2-4 or more	16.6 μ	"

The mark × denotes presence, otherwise absence.

TABLE II.

Showing the various characters of the spodograms in the leaves of different species belonging to *Sasa* MAKINO et SHIBATA.

Species	Criteria				The number of cell rows constituting the bands of articulation cells	The length of stomata in the epidermis on the under surface	The walls of a geniculate hair on the under surface
	Hairs on the upper surface of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves	Hairs on the under surface of leaves			
<i>Sasa paniculata</i>					1-3	21.6-28.2 μ	smooth or serrate
<i>S. iyoensis</i>	×		×	×	1-3	23.2-24.9 μ	"
<i>S. coreana</i>	×		×		1-3 or more	21.5-26.5 μ	smooth
<i>S. nipponica</i>	×		×	×	1-3 "	21.5-24.9 μ	"
<i>S. Hayatae</i>	×		×	×	2-3 "	24.9-26.6 μ	"
<i>S. Tokugawana</i>		×	×	×	1-3 "	19.9 μ	smooth or serrate
<i>S. tyuhgokensis</i>		×	×		1-3 "	24.9-26.6 μ	"
<i>S. Veitchii</i>		×	×		1-3 "	21.5-24.9 μ	"
<i>S. Makinoana</i>	×	×	×	×	1-3 "	24.9-29.9 μ	"
<i>S. bitchuensis</i>	×	×	×		1-3 "	21.6-29.9 μ	"
<i>S. nebulosa</i>				×	1-3 "	21.5-23.2 μ	"
<i>S. kurilensis</i>	×		×		1-3 "	24.9-28.2 μ	"
<i>S. stenantha</i>			×		1-3 "	19.9-23.2 μ	"
<i>S. nana</i>			×	×	1-3 "	21.5-24.9 μ	"
<i>S. Tsuboiana</i>			×	×	1-3 "	21.5-24.9 μ	"

The mark × denotes presence, otherwise absence.

TABLE III.

Showing the various characters of the spodograms in the leaves of different species belonging to *Pseudosasa* MAKINO.

Species	Criteria				The number of cell rows constituting the band of articulation cells	The length of stomata in the epidermis on the under surface	The walls of a geniculate hair on the under surface
	Hairs on the upper surface of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves	Hairs on the under surface of leaves			
<i>Pseudosasa Ōwatarii</i>			×	×	1-8 or more	22.1-25.5 μ	smooth
<i>Ps. japonica</i>			×		1-4 "	21.6-26.6 μ	"
<i>Ps. spiculosa</i>					1-5	19.9-33.2 μ	"

In *Pseudosasa spiculosa* MAKINO, silica cells which are found on the epidermis above the veins on the upper surface of a leaf are seldom seen piling upon the shorter cells, but in *Pseudosasa Ōwatarii* MAKINO and *Pseudosasa japonica* MAKINO, they are seen adjoining to the shorter cells.

TABLE IV.

Showing the various characters of the spodograms in the leaves of different species belonging to *Sasaella* MAKINO.

Species	Criteria				The number of cell rows constituting the bands of articulation cells	The length of stomata in the epidermis on the under surface	The walls of a geniculate hair on the under surface
	Hairs on the upper surface of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves	Hairs on the under surface of leaves			
<i>Sasaella Hisauchi</i>					2-3 or more	26.6-28.3 μ	smooth
<i>Sasael. ramosa</i>	×	×	×	×	2-3 "	23.2-28.2 μ	smooth or serrate
<i>Sasael. hannoensis</i>	×		×	×	1-3 "	23.2-24.9 μ	smooth

The mark × denotes presence, otherwise absence.

TABLE V.
Showing the various characters of the sporograms in the leaves
of different species belonging to *Pleioblastus* NAKAI.

Criteria Species	Hairs on the upper sur- face of leaves			The number of cell rows constituting the bands of articulation cells	The length of stomata in the epidermis on the under surface	The walls of a geniculate hair on the under sur- face	Silica cells in the upper epidermis above the veins		
	Hairs on the upper sur- face of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves				4.9-16.6 μ	in length, 13.3-19.9 μ	in width.
<i>Pleioblastus linearis</i>		x	x	2-4 or more	21.6-29.9 μ	smooth or serrate	4.9-8.3 μ	"	"
<i>Pl. communis</i>		x	x	2-4	24.9-28.2 μ	smooth	3.3-6.6 μ	"	"
<i>Pl. Usawai</i>	x	x	x	2-3	14.9-21.6 μ	"	3.3-6.6 μ	"	"
<i>Pl. Kurishii</i>	x	x	x	1-3	18.3-24.9 μ	"	3.3-6.6 μ	"	"
<i>Pl. yamakitensis</i>	x	x	x	2-3	21.6-29.9 μ	"	6.6-9.9 μ	"	"
<i>Pl. variegata</i>	x		x	2-3	16.6-26.6 μ	"	3.3-9.9 μ	"	"
<i>Pl. oiwakeensis</i>			x	1-3	16.6-24.9 μ	"	3.3-4.9 μ	"	"
<i>Pl. Simoni</i>			x	1-3	18.3-24.9 μ	smooth or serrate	4.9-8.3 μ	"	"
<i>Pl. Chino</i>			x	2-3	21.6-28.2 μ	"	4.9-8.3 μ	"	"
<i>Pl. nitakajamensis</i>	x			1-3	16.6-24.9 μ	smooth	4.9-6.6 μ	"	"
<i>Pl. gramineus</i>				2-3	24.9-28.2 μ	smooth or serrate	3.3-4.9 μ	"	"

The mark x denotes presence, otherwise absence.

TABLE VI.
Showing the various characters of the spodograms in the
leaves of *Phyllostachys* SIEBOLD et ZUCCARINI.

Species	Criteria	Hairs on the upper surface of leaves	Geniculate hairs on the upper surface of leaves	Spine cells on the upper surface of leaves	Hairs on the under surface of leaves	The number of cell rows constituting the bands of articulation cells	The length of stomata in the epidermis on the under surface	Silica cells in the upper epidermis above the veins
<i>Phyllostachys bambusoides</i>			×	×	×	2-3 or more	16.6-21.6 μ	6.6-16.6 μ in length, 14.9-24.9 μ in width.
<i>Ph. Makinoi</i>			×	×		2-3 "	16.6-24.9 μ	" 13.3-16.6 μ "
<i>Ph. nigra</i> var. <i>Heronis</i>				×	×	2-3 "	14.9-26.5 μ	" 11.6-19.9 μ "
<i>Ph. mitis</i>				×		1-3 "	16.6 21.6 μ	" 9.9-16.6 μ "
<i>Ph. nigra</i>						1-3 "	19.9-25 μ	" 11-15.5 μ "
<i>Ph. nigripes</i>						1-3 "	21.6-26.5 μ	" 11.6-18.3 μ "
<i>Ph. formosana</i>						1-3	16.6-24.9 μ	" 11.6-18.3 μ "

The mark × denotes presence, otherwise absence.

Generally speaking, there can be no doubt but that leaves have some characters which may be regarded as criteria for the determination of different species. Yet it may well be said that they never possess all the characteristics for the classification of species.

For all that, I feel extremely satisfied that I was able to have classified all the species belonging to the Japanese Bambusaceae which I have examined, by means of the spodograms of leaves, as have been shown in the foregoing descriptions and tables. It should be here mentioned, however, that I am very anxious as to the further result of the present study when extended to another group of the same family existing in the countries outside of Japan, as I have used in this work as materials only a small portion of the leaves of the species growing in the Empire. Moreover, some genera such as *Sasa*, *Sasaella* and *Pseudosasa* bear so much resemblance as to their spodograms that I have found it extremely difficult to distinguish one from the other. This, I think, is most likely due to the fact that they came from the same phylogenetic branch.

Anyhow, the Bambusaceae are a very difficult family for a taxonomist who generally takes mere external characters into consideration. They present even more difficulty in the case where materials for a taxonomical study are but fragmental, and are even wanting flowers. Under these circumstances, I feel quite convinced that the method of classifying species by means of spodograms is the only reliable one, and that it is all the more so, since it is quite simple and is a practical method, as was already mentioned in the beginning of this paper.

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